An Empirical Investigation into the Use of Product Development in the Educational Furniture Industry

A thesis presented in fulfilment of the requirements for the Master of Technology in Product Development at Massey University, Palmerston North, New Zealand.

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Abstract

An empirical investigation into the use of product development in the educational furniture industry is summarised in this thesis. New Zealand furniture manufacturers are facing increased competition from imported furniture and are also exporting more and more furniture. Developing new products is therefore important to the New Zealand furniture industry's growth.

This research was based on a small furniture-manufacturing firm from Hastings, New Zealand called Furnware Industries Limited (Furnware). A product development process was developed to their specific needs by comparing their current product development activities with identified best practices in product development. Those parts of the current activities that worked well were amalgamated with the structured Stage-Gate™ process of Cooper (1998).

This process was tested by using it to develop a Mobile Technology Education Workstation range for Furnware. The aim of the project was to develop a new product for Furnware to sell and to simultaneously test the developed process. Once the project was completed, an evaluation of the product development process used was undertaken. Several areas for improvement were identified and a revised process outlined.

The use of Computer-Aided Design (CAD) software was identified as another area of improvement that would assist both product development activities and existing manufacturing processes at Furnware. Consequently, a CAD package best suited to Furnware is selected using a structured process.

The three main outcomes of the research were:

1. A product development process suited to Furnware.
2. A Mobile Technology Education Workstation range of products ready for launch, pending minor adjustments and testing.
3. A CAD software package suggested for use at Furnware.
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1 Introduction

Product Development is the process of turning ideas into new products. This thesis outlines the use of product development in the furniture industry. The furniture industry in New Zealand is facing increased competition from overseas furniture manufacturers due to ever decreasing import tariffs. "Imports for the December 2000 year totalled US$216 million which was an increase of 9.3% over the previous year". (Dunnett, 2001). The low value of the New Zealand dollar has provided better opportunities to compensate for this new market pressure by increasing furniture exports. "Due to increasing import competition and a greater export focus, New Zealand companies are concentrating on qualities such as unique design, quality, delivery and service...". (Dunnett, 2001). The development of new furniture products is therefore important to the New Zealand furniture industry's growth. This thesis outlines the use of a structured product development process to develop a new furniture product. The process is evaluated at the conclusion of the project and refined to better suite the sponsor company's situation. It is recommended that this process be used for future projects to help improve product development at Furnware. As with any newly adopted process it should also be improved over time.

1.1 Company Background

1.1.1 History

Furnware is a furniture manufacturing company located in Hastings, New Zealand. Furnware began operations in 1934 and has been a manufacturer of products ranging from children toys to coffins. Since then the company has also been a manufacturer of caravans and a supplier of kitchens for government houses. The company has also had a number of owners from large corporate companies to the present, privately owned and operated setting.

1.1.2 Current Product Range

Furnware currently manufacture products for the education, healthcare/rest home and domestic solid timber markets. The recent purchases of two companies: Permakraft Furniture and Eagle Furniture has increased the product range to over 600 standard
products. Permakraft produce household solid wood furniture, while Eagle and Furnware focus on educational furniture. Several examples of the current furniture range are given below in Figure 1-1.

**Figure 1-1 Examples of Existing Furnware Products**

(Source: Furnware Industries Limited product catalogue 2001)

1.1.3 Business Strategy

1.1.3.1 Product

To produce high quality, well designed furniture at a reasonable cost. Product innovation and quality play a key role in protecting sales prices that are higher than the market norm. The ability to supply customers with 'one-off' designs, thus better meeting the customers' needs is another key factor in Furnware's product strategy. Furnware's current commitment to research is the result of a change in product development strategy, from being a reactor to market changes and customer demands, to being a market leader in supplying products that meet customer needs.

1.1.3.2 Marketing

Furnware's market strategy involves building strong relationships with key customers, such as school principals and then developing long-term relationships. The location of sales representatives throughout New Zealand allows Furnware to contact customers on

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1 One-off designs are new product designs that have been specifically requested by a customer. Sometimes referred to as custom designs.
a regular basis. Furnware is currently establishing itself in the US market, by partnering with several other New Zealand companies and the New Zealand Trade Development Board (TRADE NZ). This is expected to provide a much larger customer base, as well as an increase in sales during the traditionally slow sales months of the New Zealand winter (June-September).

1.1.3.3 Production

To manufacture products as economically as possible, while maintaining current product quality. Production strategy involves the development of a system that can produce both standard and ‘one-off’ products by the date required by the customer, and be flexible and cost effective. Raw materials used consist of Medium Density Fibreboard (MDF), Melteca, solid wood (Rimu and Pine) and mild steel. The steel used is predominantly round or square tube of varying dimensions.

1.2 Overall Research Method

Provided below in Figure 1-2 is the flowchart for the overall research method. This research was based on Furnware’s operations. A combination of research into existing company product development activities and product development theory was conducted. These two areas were used to develop a product development process for Furnware. Identified best practices were researched and used to provide guidelines for the revised product development process. This process was then used to develop a product idea. The purpose of this project was to develop a new product for Furnware and to simultaneously test the proposed product development process. After completing the project, the process is evaluated and revised to better suite Furnware’s needs. The use of CAD technology was identified as a key factor in improving product development and production at Furnware, consequently research into which CAD package would most suite Furnware was also done. Provided below is a brief introduction to each of the research areas.
1.3 Existing Company Processes

Furnware is a small furniture manufacturing company located at Hastings, New Zealand. This company agreed to partner this research project. This section covers research into Furnware, in particular existing product development methodologies. A brief history and product background is also given. To research current product development activities at Furnware two case studies were used. These studies each reviewed a recent development project undertaken at Furnware. The studies resulted in the development of a current general process that is used at Furnware. The process is informal and most projects do not follow all the steps.
1.4 Product Development Theory

Research into current product development processes was conducted to help improve product development at Furnware. The processes will be used to provide a basis from which a product development process suited to Furnware's particular situation is developed. The details of this development are provided in Chapter 3: Process Selection.

Cooper (1998) presents a five-stage, stage-gate process that suits Furnware's industry situation. The five stages are:

- **Stage 1** Preliminary Investigation.
- **Stage 2** Detailed Investigation.
- **Stage 3** Development.
- **Stage 4** Testing and Validation.
- **Stage 5** Full Production.

Gates divide the stages. The gates represent times in the process where top management makes decisions on the project. They also approve an action plan for the next stage.

Earle (1999) also outlines a structured process with stages divided by decision points. The process has four stages.

- **Stage 1** Product Strategy Development.
- **Stage 2** Product Design.
- **Stage 3** Product Commercialisation.
- **Stage 4** Product Launch and Evaluation.

Decision points where top management makes a Go or No-go decisions on the project separate these stages. This process is more suited to the development of food products than furniture products. The use of a structured process, with clear decision points is consistent with Cooper's process though.

The third process outlined is that described by Ulrich & Eppinger (2000). They outline a generic process with six stages.

- **Stage 0** Planning.
- **Stage 1** Concept Development.
- **Stage 2** System-level Design.
- **Stage 3** Detailed Design.
- **Stage 4** Testing and Refinement.
Stage 5  Production Ramp-up.
Ulrich & Eppinger illustrate the multi-disciplinary approach to product development by listing the typical tasks needed to be carried out by marketing, design and manufacturing at each of the stages. This process is best suited to a product that incorporates a high level of engineering due to the emphasis on testing and works well for high-volume production companies because it incorporates a production ramp-up stage. Ulrich & Eppinger include Stage 0 Planning in their process; this is an important part of product development within a company. While not included in Cooper's process he does consider it critical to successful product development. Research into these processes assisted the development of a product development process at Furnware by providing structured approaches to product development. Chapter 3 outlines the development of a product development process suitable for use at Furnware that is based on Cooper's Stage-Gate™ process.

1.5 Best Practices in Product Development

Best practices in product development are those activities conducted by companies that improve product development within the company. Griffin (1997) summarises the results of a Product Development Management Association (PDMA) research project into best practices in product development. The main findings are provided in the literature review. The report also discusses current product development trends. Cooper (1998) also provides practices that are undertaken by companies that are successful at product development. He identifies three cornerstones of success.

- Having a new product strategy.
- Having the right resources.
- Having a new product process that works.

He identifies five success factors in developing a high quality process as well. These are summarised in the literature review. These best practices are used to determine in which areas Furnware should improve in their product development activities.

1.6 Revised Product Development Process

A product development process is developed for Furnware by combining current practices at Furnware with identified product development processes. To do this a comparison is made between, the best practices and Furnware's current practices. From
this analysis two areas were chosen for improvement. The first was the use of a structured product development process and the second was the use of CAD technology. Using CAD technology to increase design efficiency will help the product development process at Furnware as well as improve current manufacturing processes. Research into this area is provided in Chapter 9 of the thesis.

The research into the existing product development processes of Cooper, Earle and Ulrich & Eppinger is used to develop a structured product development process for Furnware. Cooper’s process is selected as the basis for the new process. The new process also incorporates current activities identified as already working well at Furnware.

1.7 Mobile Technology Education Workstation Project

The development of a product for Furnware was done for two reasons.

1. To test the process developed for Furnware.
2. To develop a product Furnware could sell and profit from as a part of their existing range of furniture.

The development of a Mobile Technology Education Workstation range started with an investigation into three product areas:

- A mobile workstation for the technology curriculum.
- A mobile workstation for computer equipment.
- A mobile workstation for audio-visual equipment.

The preliminary investigation into these areas led to the decision to develop a workstation for the Technology Curriculum in primary schools. The project brief was:

To design a Mobile Technology Education Workstation that will assist in the practical component of technology education in primary schools in New Zealand. The workstation will attempt to cover all the areas of the Technology Curriculum. If this is not feasible, a family of workstations will be developed. The unit will provide both storage and working surface suitable for conducting typical practical technology education activities.

A detailed investigation into this specific product area was completed next. A target market was identified; competitor products analysed and consumer needs information was collected. Generation of concepts was done using a structured five-stage method.
The outcome, after screening was two concepts chosen for further development. To develop the concepts into final product designs a series of prototyping, testing and concept development was done. The concepts were developed to a stage where one idea was selected for final prototyping and testing.

There were three final tests done on the workstation. Concept functionality testing to ensure the design functioned well. Consumer appeal testing to ensure aspects such as aesthetics and price were acceptable. Structural integrity testing was the final test done. The workstations passed these tests with only a few design modifications suggested. Finally commercialisation plans are presented.

1.8 Project Evaluation

Once the Mobile Technology Education Workstation project was completed, the process used could be evaluated. The process is evaluated both by development stage and as a whole. Interviews with top management at Furnware provided the basis for much of the evaluation. A review of the literature summarised in Chapter 2 helped provide suggestions for future improvement, as did the suggestions from the top management evaluation. A revised process that integrates Stages 2 & 3 of the process used to develop the Mobile Technology Education Workstation into a single, cyclic process is the result of this evaluation. Incorporation of company knowledge and top management is also added into the process.

1.9 CAD Selection

During the comparison of current practices at Furnware and identified best practices in product development, the use of engineering tools was identified as an area that Furnware could benefit from in both product development activities and existing manufacturing processes. Consequently a CAD package is selected for use at Furnware. The selection process included:

- Collecting information on all of Furnware’s current needs.
- Researching the CAD software packages available.
- Conducting an initial screen of packages by ensuring they had the features required by Furnware.
Completing a second, more detailed financial analysis on the remaining packages to determine which package would provide the greatest return on investment (highest Net Present Value).

The software package that rated highest in the NPV analysis was not considered the best overall though, due to qualitative factors that could not be incorporated into the analysis.

1.10 Summary

This chapter introduces the sponsor company, Furnware Industries Limited and the main areas of research that this thesis covers. The structure of the overall thesis is provided and a clear explanation for why each of the areas was researched is summarised. Each section is then introduced and a brief description of the activities conducted and outcomes from them given. This chapter precedes Chapter 2: Literature Review, which provides a summary of the current, relevant literature on this topic.