

**A box manufacturing cost analysis  
at *B.R.H. (PTY.LTD.)***

**by**

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## Abstract

The debate about choosing outsourcing over in-sourcing and vice versa has been going on for decades now, with no clear answer in sight. This decision forms part of a company's business strategy. Many have developed their own frameworks to assist in deciding which sourcing strategy is best for their business. This is not a once-off decision, as it needs to be reviewed over time, especially as the business grows. This study investigates the feasibility of in-house manufacturing of packaging material at *B.R.H. (PTY.LTD)*, a cleaning products manufacturing facility. The results will assist the owner to determine whether the manufacturing of his own packaging material would be cost reducing and profitable. This project is conducted in two phases; firstly to determine cost-effectiveness of the investment if *B.R.H.* only manufactured packaging material for their own use. Secondly, to determine if this could turn into a profitable new business venture. A cost analysis was performed using Monte Carlo simulation, to determine what the expected costs would be. This was plotted against the outsourcing costs to determine if and when the costs will break-even (meet). The initial findings showed that the cost to manufacture only what the company requires, on a monthly basis exceed the outsourcing costs. However if production is increased, the excess cardboard can be sold to reduce the manufacturing expense.

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# Chapter 1

## Background

*B.R.H. (PTY.LTD)* is a family owned bulk manufacturer and wholesaler of cleaning products and accessories. Under the *B.R.H.* name the family operates three distinct manufacturing companies namely: *B.R.H. Chemicals (PTY. LTD)*, *SUN BRIGHT Polishers (PTY.LTD)* and *B.R.H. Brushware & cleaning accessories (PTY .LTD.)*

*B.R.H. (PTY.LTD)* describes themselves as 'manufacturers of high quality' products at competitively low prices. They achieve high quality cleaning products with the use of high quality raw materials which are internationally sourced. Raw materials such as caustic, pine oil and fabric base are procured from China, Switzerland, UK and Brazil. *B.R.H.( PTY. LTD)* achieves economies of scale by lowering the average cost per unit through increased production, since fixed costs are shared over a number of goods.

This has attracted a variety of customers from housewives in the surrounding area to government institutions such as hospitals, schools, correctional facilities and military facilities within South Africa, and beyond its borders. The company doesn't merely manufacture all their products; they package and distribute them as well. Keeping these activities in -house allows them to manage and control the costs associated with the manufacturing of each product.

Due to the increase in demand, the owner expanded operations to Pretoria. This manufacturing plant has been in operation for over a year. The manufacturing plant manufactures dish washing liquid, pine gel, polish and hand- wash, to name but a few. It also warehouses other products such as toilet rolls, mops and brooms which are manufactured at the parent manufacturing plant in *Boschkop*.

The owner would like to take advantage of the market by decreasing his costs and ultimately expanding his business to include the manufacturing of packaging material. This requires cost analysis to compare in-sourcing and outsourcing of packaging material.

## Chapter 2

### Introduction

#### 1. Project Aim

The main aim of this project is to determine whether the manufacturing of packaging material at *B.R.H.* would be cost reducing and profitable.

Objectives acting as the basis of the aim:

- A Swot analysis is performed to get a better understanding of the company's current position in order to get a clearer view of its potential future.
- Cost analysis to compare in-sourcing and outsourcing.
- Analytical Hierarchy Process for machine selection.
- Monte Carlo simulation is used to determine more accurate output for total monthly expenses for this new department.

#### 2. Project Scope

This study aims to provide the owner with information regarding the sourcing strategy for packaging material; particularly cardboard boxes, at *B.R.H.* .This will be accomplished in two phases:

The first phase will be carried out in the following steps. A swot analysis is performed to get a better understanding of the company's current position in order to get a view of its potential future. Corrugated cardboard boxes were identified to be the most costly packaging expense at *B.R.H.* A box manufacturing machine was then selected using the analytical hierarchy process (AHP) taking into consideration a number of factors such as cost, location of supplier and output rate. All costs associated with the set up and operation of this new department, were identified and based on the *B.R.H.*'s monthly demand that they currently outsourced. For an accurate output of variable costs Monte Carlo simulation was used and the final costs were compared with the outsourcing expense to determine if the costs broke-even (meet).

The second phase expands on the first to identify if the increase of production would result in a profitable product that *B.R.H.* could sell.

# Chapter 3

## Literature study

### 1. Industry analysis

'An industry is made up of enterprises engaged in the same or similar kind of economic activity. Industries are defined in the *System of National Accounts (SNA)* in the same way as in the *Standard Industrial Classification of all Economic activities, Fifth edition.*'(Wholesale trade sales, 2012:12) There are a number of industries in a country and they are monitored to assess their performance.

#### 1.1. The wholesale industry

The wholesale industry differs from the retail industry simply because the retail sells directly to the consumer and the wholesale sells to other businesses or the government. In order for a business to be known as a wholesaler, 50% or more of the turnover should come from the sales of goods to other businesses and institutes (Stats SA, 2012).

According to Statistics South Africa's, preliminary statistical report on wholesale trade sales for February 2012, wholesale trade sales increased by 13.9% year-on-year in real terms and 21.7% year-on-year in nominal terms.

The three major contributions to the increase were: dealers in solid liquid and gaseous fuels and related products, dealers in machinery, equipment and suppliers and dealers in the other household goods, except precious stones.

The figure below shows the trend of wholesale trade at constant 2000 prices (in real terms) from January 2006 to January 2012. It seems to be gradually increasing over the past 6 years.

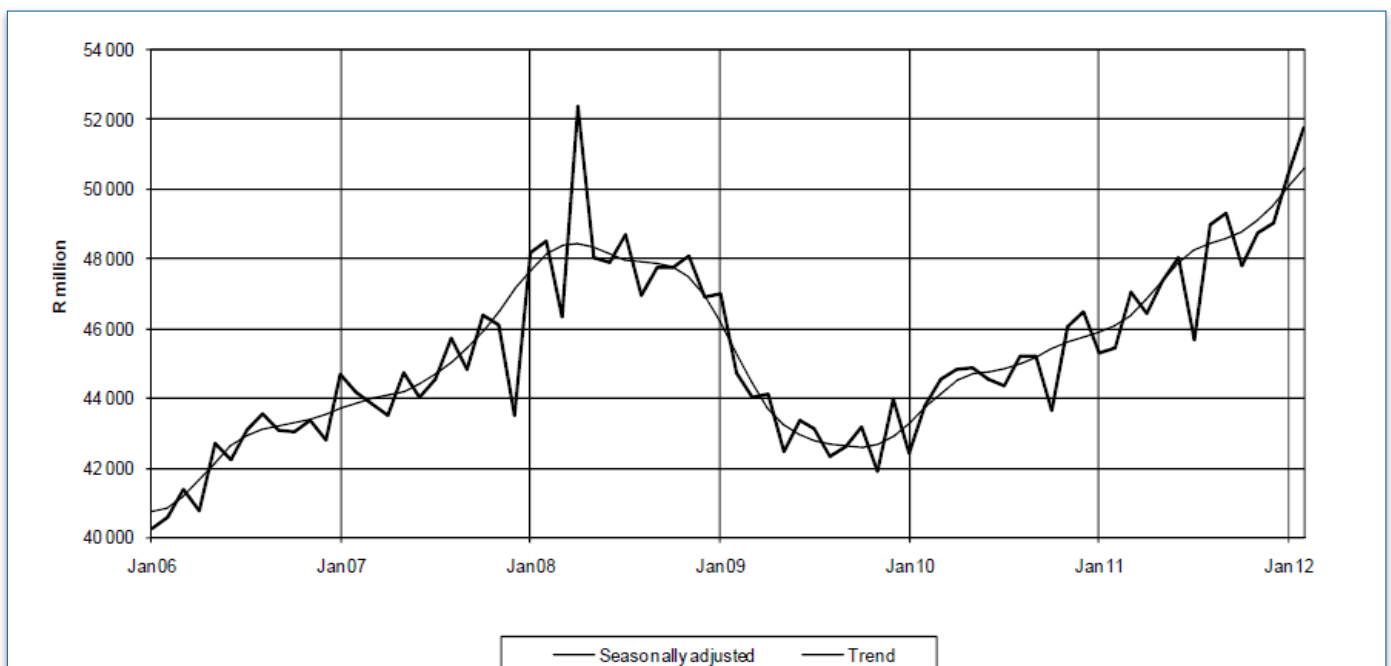


Figure 1: Graph depicting the trend of wholesale trade at constant 2000 prices (in real terms)



## 1.2. The manufacturing industry

South Africa's manufacturing production for February 2012 increased by 4.1% compared with February 2011 (Stats SA: *Preliminary statistical report*, 2012). The figure below illustrates the index of the physical volume of manufacturing production 2006-2012.

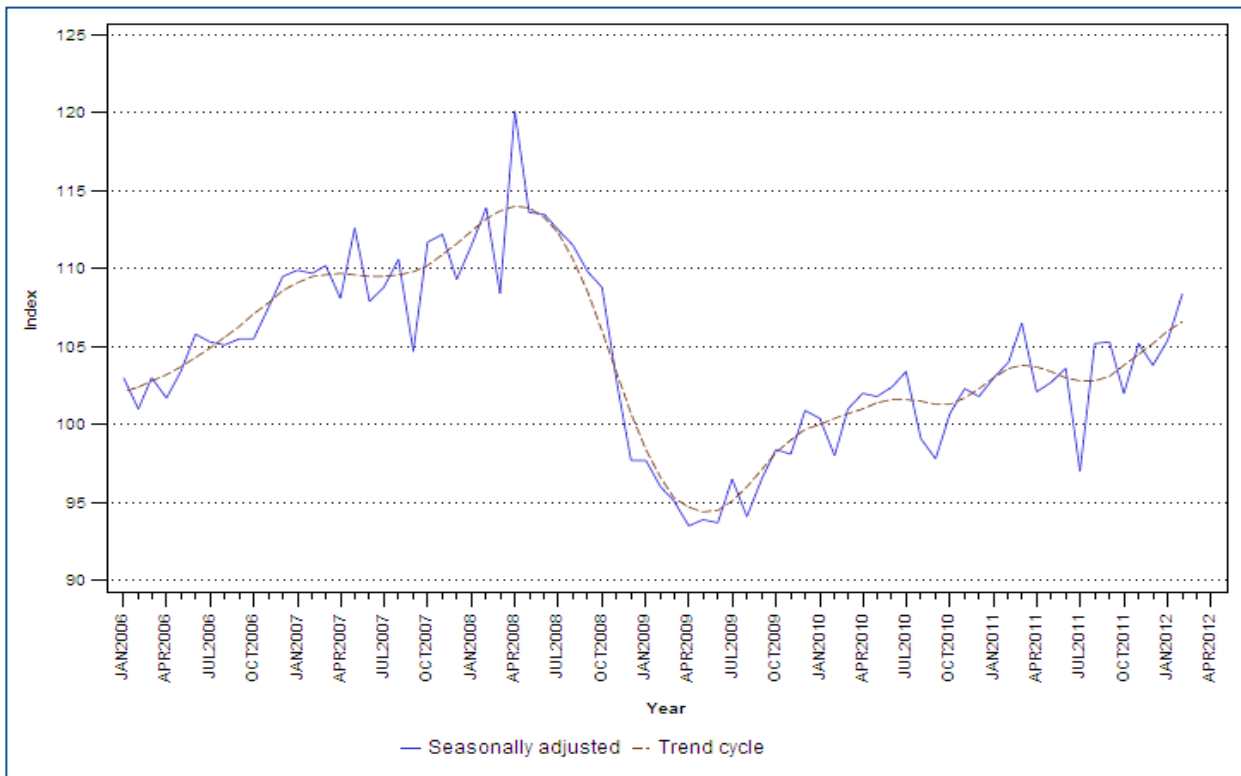


Figure 2: Graph depicting the index of the physical volume of manufacturing production 2006-2012

It can be seen from the graph that manufacturing activity in SA declined sharply in 2008 during the financial crisis, but the industry has been expanding since early 2010. The crisis has not been averted as yet according to Stewart Jennings, chairman of the Manufacturing Circle. Jennings told *BusinessLIVE*, "We are the only country in the world advocating a strong currency, which negatively affects our manufacturing competitiveness due to our cost push environment, which is mainly through administered price increases such as electricity tariffs, port charges, toll fees and even natural gas costs." Jennings went on to say "for industry to be nurtured through duties, it needs to be export led and local wholesalers and retailers need to support local manufacturing." This is a solution to ensure competitiveness of the sector (Maswanganyi, 2012).

## 1.3. Summary

According to Statistic South Africa's preliminary statistical report 2012, the wholesale and manufacturing industry have shown a significant increase over the past year. These increases show that both markets indicate a favourable trend which justifies entering the market due to potential profits to be made.

## 2. In-sourcing vs. Outsourcing

The decision to in-source or outsource within any organisation (from business to manufacturing) forms part of the strategy of the organisation. Due to changing dynamics of the external marketplace and the desired future state of the organisation, sourcing strategies are revised constantly. Investigations involve elements of cost, change management and level of integration of an organisation (Karamouzis, 2007).

The focus; in terms of how resources are used in a company can be determined ,by understanding the outsourcing or in-sourcing of business activities in relation to the company's business objective (*Outsourcing vs Insourcing in a Global world: 2007*).

### 2.1. In-sourcing

When an organisation 'in-sources' a business function, it makes a decision to produce a product or service, using their own funds and resources.

Although research (*Outsource2India: 2012; A conceptual Framework for understanding the outsourcing decision: 1999*) shows that outsourcing seems to be a global trend, many companies still agree that there are numerous advantages linked to in-sourcing, if done correctly. There is an online company ('*Go Insource*') that provides a web-based tool to assist companies with their in-sourcing decision making. They provide a 'fully hosted solution designed simply to manage your resourcing challenges and maximise your profit.' If an organisation experiences fluctuations in work load they should distribute and manage these business functions amongst your current employees, rather than outsource.

The two main advantages of in-sourcing are:

- ♣ Control of quality and reputation

In-sourcing a business function represents a decision to retain control over the function. By doing so the business ensures that their reputation stays intact by providing quality services or products to their customers.

- ♣ Costs

The costs associated with in-sourcing can be minimised by using available resources, close management and control of the in-sourced business functions.

Other than these advantages, in-sourcing can also be organization building; a new business centre or facility which would specialize in a particular service or product (*Outsourcing vs Insourcing, n.d.*).

### 2.2. Outsourcing

The rise of outsourcing started from the beginning of the '80's when organisations decided to outsource non-core functions to different organisations that specialises in those functions (*The changing world of outsourcing, n.d.*). Outsourcing allowed them to:

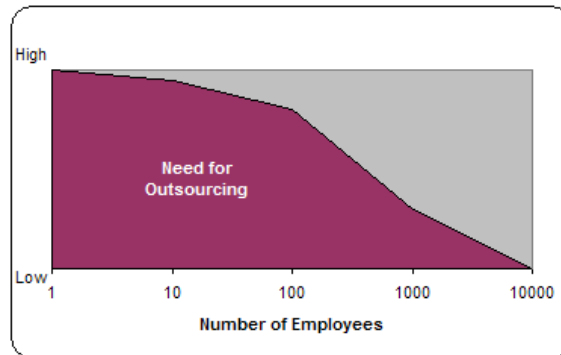
- ♣ Focus resources(staff and equipment) on the business' core functions
- ♣ Turn fixed costs into variable costs.
- ♣ Share risk with a third party.
- ♣ Achieve better stock control.

There are a number of benefits resulting from outsourcing, one more attractive then the next; however there are also many drawbacks associated with outsourcing which should be closely considered.

Drawbacks that one could face when outsourcing are: (*In-house manufacturing or outsourcing, n.d; Outsourcing benefits , n.d.*)

- ♣ After a while the supplier might take advantage of the customer due to increased dependency.
- ♣ The supplier could take advantage of customer due to superior experience in industry.
- ♣ Suppliers may be working for competitors as well; this could lead to the transferring of business information which might put your company at a competitive disadvantage.
- ♣ The shared risk that leads to the success of your business depends on the success of your suppliers business.

Another way to look at the need for outsourcing is illustrated in the figure below: it shows the relationship between company size and potential need for outsourcing. As the company size increases, the potential need for outsourcing drops dramatically. (*In house versus outsourcing*, n.d.)



**Figure 3: Illustrates the relationship between company size and potential need for outsourcing**

### 2.3. Summary

The debate for choosing outsourcing over in-sourcing and vice versa has been going on for decades now with no clear answer in sight. Many frameworks have been developed by different companies, within different industries, to assist in finding the best sourcing strategy.

A number of these frameworks help you to perform the following steps:

1. Develop an outsourcing and in-sourcing plan for all non-core business functions.
2. Identify risks, cost, non-financial benefits as well as disadvantages of each plan.
3. Compare the two sourcing options according to cost, risk and benefits.

(First: *Furniture industry in restructuring: systems & tools*, n.d. ; *Gartner: Insourcing vs. outsourcing in Global World : 2007*; Vining and Globerman : 1999)

These steps help to break down the cost of outsourcing and in-sourcing for comparison. The decision basically boils down to:

- Which alternative reduces costs in most situations (depending on short term or long term requirements).
- The availability of resources such as staff and equipment.
- Budget of the company.

### 3. Industrial techniques used

#### 3.1. SWOT analysis

The SWOT analysis is a tool for understanding and decision-making in businesses and organisations. It was developed from the research conducted at the Stanford Research Institute from 1960-1970 (Business *Balls: SWOT analysis History- The origins of the SWOT analysis model: n.d.*). SWOT is an acronym for Strengths, Weaknesses, Opportunity, Threats. When completing a SWOT analysis in most business situations, strengths and weaknesses are regarded distinctly as internal factors, whereas opportunities and threats are regarded distinctly as external factors. The figure below shows the relation between Strengths, weaknesses, opportunities and threats once they have been identified.

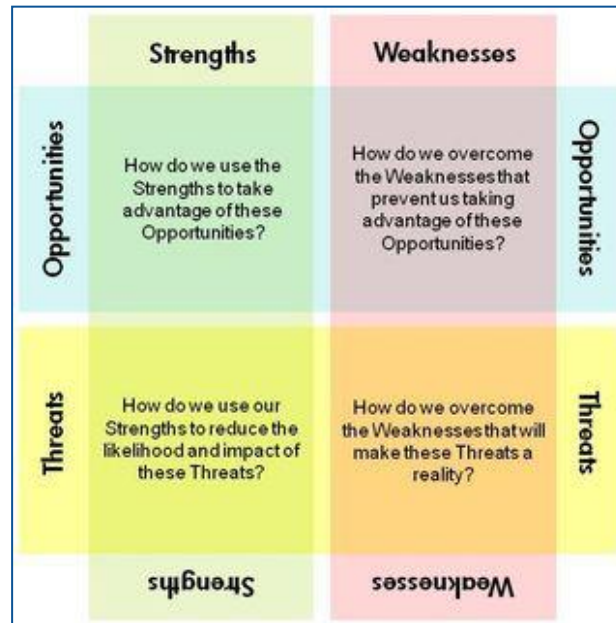


Figure 4: SWOT analysis relationship

'Swot Analysis is a good evaluation tool to determine the quality of the best strategies and ideas' (Organising *Information (Part 2, Swot Analysis)*, 2009).

#### 3.2. Monte Carlo simulation

Monte Carlo simulation is a sampling technique used in analytical decision modelling involving uncertainty. According to Anderson (1999: 1) 'Monte Carlo is the art of approximating an expectation by the sample mean of a function of simulated random variables.' Similarly, *Investopedia* defines Monte Carlo simulation as 'a problem solving technique used to approximate the probability of certain outcomes by running multiple runs, called simulations, using random variables'. Monte Carlo simulation, in very familiar terms, is about invoking the laws of large numbers to approximate expectations (Anderson 1999:1)

An analytical decision model is one that approximates the real world but gives freedom to experiment in order to understand, analyse, and facilitate decision making (Savage, 2003:3; Evans, 2010:316). The benefits of model building for making managerial decisions and engineering decisions are exactly the same. Friedman and Savage (1991) agree that it is less costly to make mistakes in a model than in real life and most importantly it allows the user to gain insight into the nature of the relationship between the components of a problem.

### 3.3. Analytical Hierarchy Process (AHP)

'Analytical Hierarchy Process is an approach to decision making that involves structuring multiple choice criteria into a hierarchy, assessing the relative importance of these criteria, comparing alternatives for each criterion, and determining an overall ranking of these alternatives' (DSS Resources).

AHP was developed by Thomas L. Saaty in the 1970s and has been extensively studied and refined since then (Kunz: 2010). AHP helps to capture subjective and objective evaluation measures while providing a useful tool for checking the consistency of the evaluation measures. It helps decision makers find the best solution to the problem.

### 3.4. Break-Even Analysis

'Since its introduction in the 19<sup>th</sup> century, the break-even concept has been used, enhanced, adjusted, and extended in an attempt to reduce or correct its limitations and make it applicable to more and more business situations' (Cafferky and Wentworth 2010:1)

A break-even point is typically calculated in order for a business to determine if it would be profitable to invest in a new idea/product. At the break-even point, no profit has been made, nor have any losses been incurred. The figure below illustrates the use of break even analysis in the form of a breakeven chart.

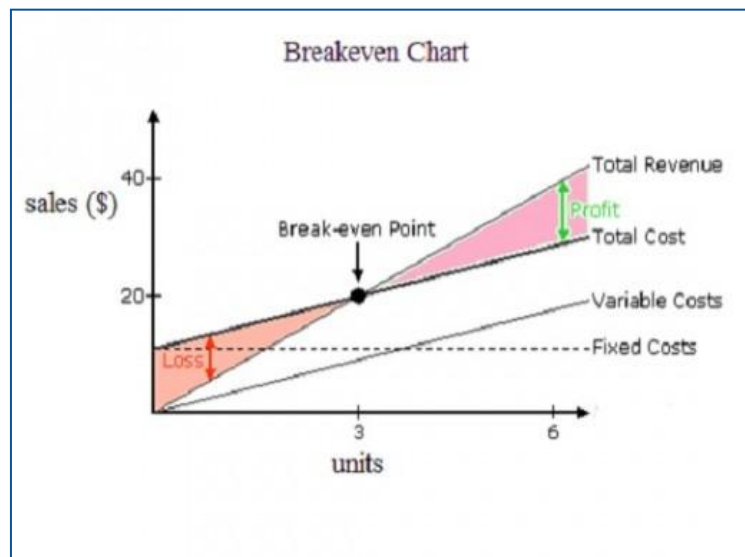


Figure 5: Depicts the break-even analysis in the form of a graph

A break-even analysis enables a business organisation to:

1. Measure profit and losses at different levels of production and sales.
2. To predict the effect of changes in the price of sales.
3. To analyse the relationship between fixed cost and variable cost.
4. To predict the effect on profitability, if there are changes in cost and efficiency.

Even with all its benefits, break-even analysis has some disadvantages: (Cafferky and Wentworth 2010:1)

- ♣ It assumes that sales prices are constant at all levels of output and production and sales are the same.
- ♣ Breakeven charts can be time consuming to prepare and it can only be applied to a single product or single mix of products.

However according to Cafferky and Wentworth (2010:1) the break-even analysis continues to be one of the best ways to focus on the relationship between cost, volume and profitability.

## 4. Cost classification

All kinds of organisations-business, non-business, manufacturing, retail and service are associated with costs. The type of organisation identifies the kinds of costs incurred and the way in which these costs are classified. There are various cost classifications, which are basically different ways of looking at costs. These cost classifications assist managers in preparing external reports, predicting cost behaviour, assigning costs to cost objects and decision making.

“Manufacturing companies make or produce goods by hand or machine. More specifically, they get involved in the conversion of raw materials into finished products, the assembling and pre-fabricated parts into a whole and the fabrication of machinery and equipment.”(Peter J. Patsula, 2001:4).

The costs linked to the start-up and operation of a new manufacturing department can be divided into two subgroups namely start-up costs and manufacturing costs.

### 4.1. Start-up costs

As defined by an online dictionary (businessdictionary.com), start-up costs are ‘non-recurring costs associated with setting up a business, such as accountant’s fees, legal fees’ and so on. All organizations require different start-up costs; however there are a few generic costs that are common to all types (Amanda Webber, 2012):

- ♣ Cost of sales
- ♣ Professional fees
- ♣ Technology costs
- ♣ Administrative costs
- ♣ Sales and marketing costs
- ♣ Borrowing costs
- ♣ Employee costs

A number of business articles all agree (Amanda Webber, 2120; *Business Startup costs: It's In The Details*, 2009) that above all, calculating the start-up costs associated with your new business, one should be realistic; by adding a miscellaneous cost item for 10% of the total budget. It will act as a buffer for any unexpected costs, as hurdles on the way.

### 4.2. Manufacturing costs

Manufacturing costs in most manufacturing companies are divided into three broad categories: direct materials, direct labour and manufacturing. (Seal, Garrison and Noreen, 2009:22).

- ♣ Direct materials of a final product, are the materials that can be physically and easily traced to it. Raw materials are defined as the materials that form a part of the final product.
- ♣ Direct labour is used to classify the labour costs that can easily be traced to individual units of product.
- ♣ Manufacturing overhead includes all the costs of manufacturing excluding direct labour and materials. This cost includes items such as indirect labour and materials, maintenance, heat, light and insurance on manufacturing facilities to name but a few.

The prime cost is calculated by adding direct labour and direct materials costs. The prime cost excludes the manufacturing costs. The conversion cost is calculated to identify the cost incurred in the conversion of materials into finished products.

### 4.3. Non-manufacturing costs

One more cost is associated with the operation of a manufacturing department, which has not been mentioned is non-manufacturing costs. These costs are generally ‘subclassed into two categories: marketing or selling cost’ and ‘administration costs’ (Seal, Garrison and Noreen, 2009:23).

- ♣ Marketing or selling costs include items such as advertising, shipping, sales travel and sales salaries. These are costs necessary to secure customer orders and get the finished product to the customer.
- ♣ Administration costs include executive compensation, general accounting, secretarial and similar costs involved in the overall general administration of the organisation.

#### 4.4. Cost classifications for predicting cost behaviour

There are two types of cost classifications relating to predicting cost behaviour: (Seal et al, 2009:33-34)

1. **Variable cost:** A variable cost is a cost that varies, in total, in direct proportion to changes in level of activity. The activity is expressed in many ways, such as units produced, units sold, miles driven and so forth.
2. **Fixed cost:** A fixed cost is a cost that remains constant, in total, regardless of changes in the level of activity.

The figure below gives examples of how some cost elements are classified.

Classifying Manufacturing Costs				
Cost Element	Classification			
	Direct	Indirect	Variable	Fixed
Raw materials	x		x	
Labor	x	x	x	x
Salaries	x	x		x
Supplies	x	x	x	x
Payroll taxes	x	x	x	x
Medical Insurance	x	x		x
Health, light, power	x	x	x	x
Telephone		x		x
Rent	x	x		x
Insur., property taxes		x		x
Depreciation		x		x

Figure 6: Classifying manufacturing costs (adapted from *The entrepreneurs Guidebook Series 2001*)



## 5. Cardboard box manufacturing

The basic cardboard box plays an important, but unpraised role in our modern society. It serves as a method to transport and store products in a safe and environmentally friendly way. This ensures that products reach the consumer in good working condition and professional manner. When manufacturing a box the following questions should be answered:

- i) *What type of box am I going to manufacture? ,*
- ii) *What material will I use to manufacture it?*
- iii) *And how will I manufacture it?*

### 5.1. Box styles

- i) *What type of box am I going to manufacture?*

There is a variety of box styles available. The European Federation of Corrugated Board Manufacturers, more commonly known as FEFCO, has compiled a guide with all possible box styles. This is in an attempt to provide simple codes that are internationally understood by all.

The FEFCO code is divided into 9 categories; this can be seen in appendix A: *FEFCO Box styles*. In each category there are a number of variations.

The most common box style is the slotted-type box; more commonly known as RSC (regular slotted container) in industrial terms. The RSC is the box style *B.R.H.* is currently using and that will be manufactured. This design is highly effective for many applications and it produces very little manufacturing waste. In particular the RSC is identified in the FEFCO code as F0201. It is described with all flaps having the same length. The outer lengthwise flaps are one and a half the container's width, so that they meet at the centre of the box when folded. For extra protection or if the product requires a flat, even bottom surface, a fill-in pad can be placed between the two inner flaps (FEFCO: 2012).

### 5.2. Raw materials

- ii) *What materials will I use to manufacture it?*

The strength of a box starts with its materials. Cardboard has a number of advantages:

- ♣ Relatively inexpensive.
- ♣ Readily available.
- ♣ Environmentally friendly.
- ♣ Array to choose from.

To increase strength and durability it is transformed into corrugated cardboard. Corrugated cardboard is basically made from a combination of two sheets of paper called liners which are glued to a corrugated inner medium called fluting. Corrugated cardboard was first used as a form of packaging material over a century and a half ago, but only after a few years had Robert Gair used it to create the RSC that is commonly used today (Boxboard containers magazine: 1998).

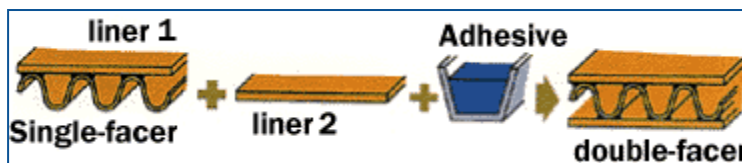
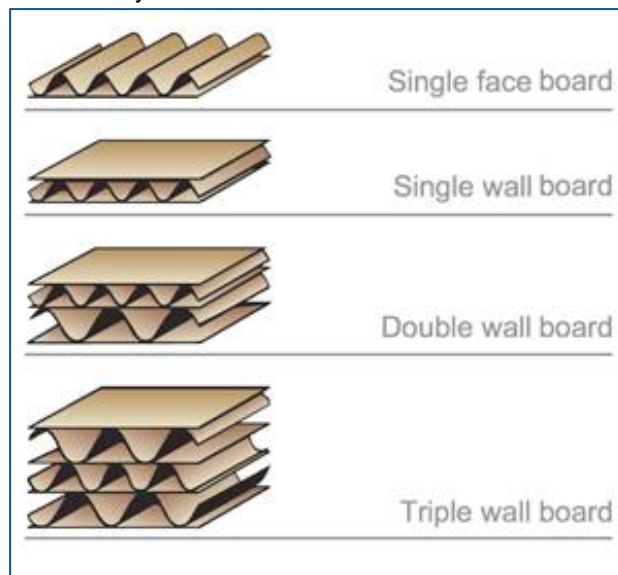


Figure 7: Depicts how corrugated cardboard is made (adapted from FEFCO: *How is corrugated made* 2012)



The assembling of these three layers is done in such a way as to give the overall structure a better strength than that of each distinct layer. Depending on the need, the layers can be combined in the following four ways to increase strength and durability:



**Figure 8:** Depicts the different types of corrugated cardboard

When used in the manufacturing of a cardboard box, these designs help thicken the walls of the box to increase resistance and rigidity. This results in a light weight box that is exceptionally resistant to puncturing, tearing and crumbling. The corrugated layers allow for air to circulate in the flutes, which provide protection against temperature variations.

These corrugated layers are available in different types, which differ in thickness and number of flutes per metre. There are eight different flutes available namely Flute A, B, C, E, F, BC, EB, BF. (More can be read in the appendix A: *Flutes sizes*).

A standard corrugated box will be made from single wall cardboard with a corrugated layer of C-flute, which is appropriate for medium to light weight packagers.

### 5.3. Manufacturing process

iii) *How will I manufacture it?*

Once the corrugated board is manufactured, it is cut into flat sheets ready for converting machines which are used to “convert” them into cardboard boxes. The most common of these machines are flexo-folder gluers and die cutters.

- ♣ A *die-cut machine* merely cuts the corrugated board into a pattern and the user will fold and glue into the box shape when needed. There are two types of die- cutters; rotary and flat die cutters.
- ♣ A *flexo-folder gluer* on the other hand; prints, creases, slots, trims and glues the box so that it can be shipped flat and then can easily be formed by the user and packed (Tappi 2001).

Either of these converting systems result in a corrugated box ready to contain, carry and cushion a product to anywhere in the world.

## Chapter 4

### Design, Implementation and Analysis

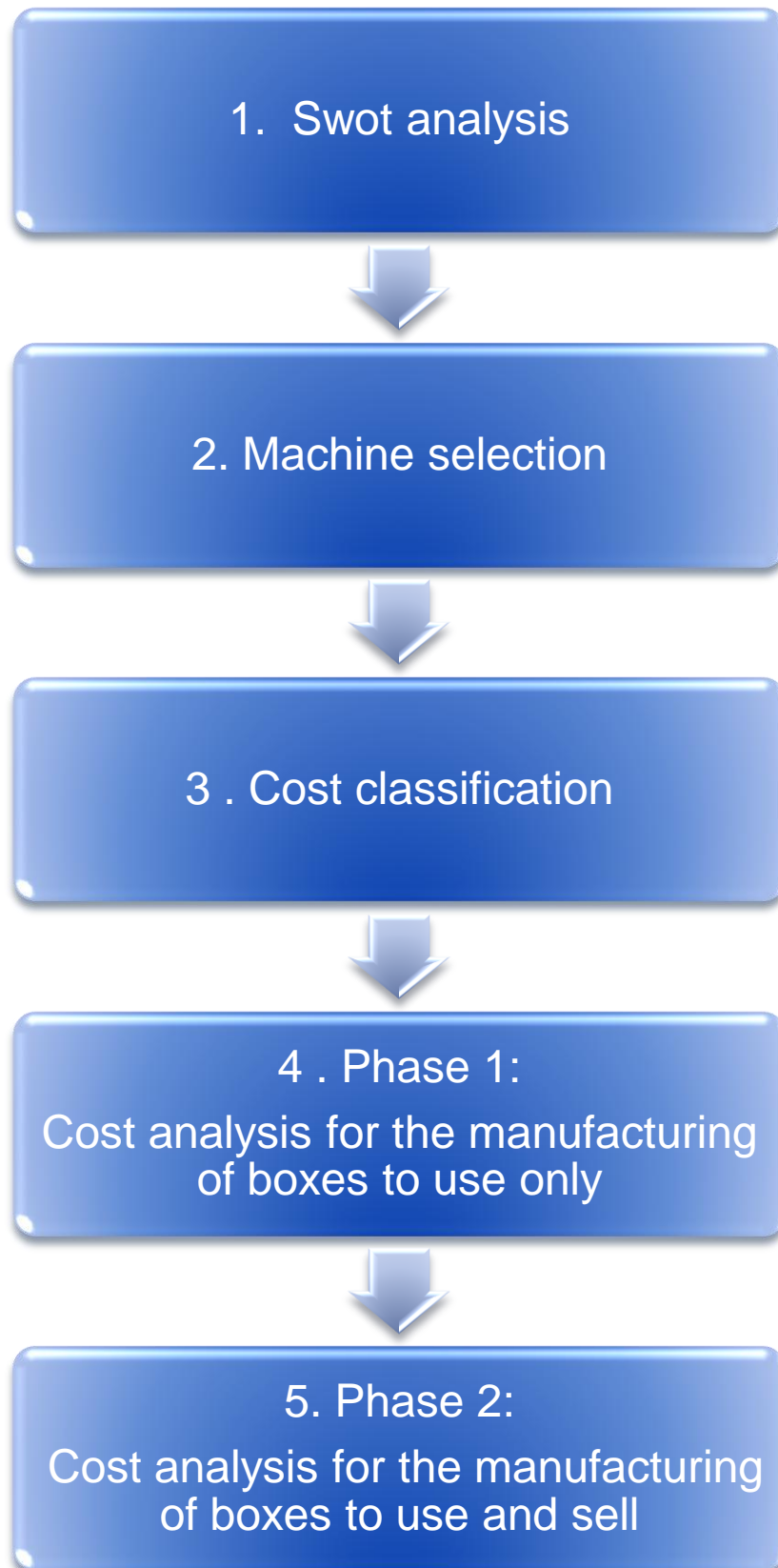


Figure 9: This depicts the steps to be followed

## 1. Swot analysis

A swot analysis was conducted for the business and the following was identified as the company's strengths, weaknesses, opportunities and threats:

### **Strengths: Advantage of an organization from internal environment.**

- ✓ Good balance sheet.
- ✓ Good reputation among customers.
- ✓ Available space.
- ✓ Personal interaction between owner, customer and suppliers for new department.
- ✓ Overseas procurement skills.

### **Weaknesses: Disadvantage of an organization from internal environment.**

- ✓ A completely new industry and market entering into and lack of knowledge
- ✓ Lack of financial resources to employ competent workforce and conduct sufficient research to enter such a business.
- ✓ Lack of marketing expertise.
- ✓ Lack of standard business hierarchy and procedures.

### **Opportunities: A chance that an organization analysed from external environment.**

- ✓ Expand product range to include packaging material.
- ✓ Diversify business interests to packaging industry.
- ✓ Expand customer base to possibly export products.
- ✓ Reduce packaging costs.
- ✓ No need to keep pallets of stock boxes (save on warehouse space).
- ✓ Franchise opportunities when getting a branded label.
- ✓ Give back to community.

### **Threats: Potential problems that an organization analysed from external environment.**

- ✓ Possible price wars with competitors
- ✓ A dramatic increase in any raw materials required e.g. fuel, electricity rates.
- ✓ Labour laws for employment.
- ✓ Lack of skilled and loyal workers in community.

To determine how these four internal and external factors relate to one another the following questions need to be answered:

#### **1. How do you leverage the company's strengths to benefit from opportunities?**

- A good balance sheet facilitates a number of the opportunities available to the company such as giving back to the community and expanding business to packaging industry.
- Having a good relationship with the customer allows *B.R.H* to use this good reputation to expand its customer base; this will allow the company to grow into a well known brand, for future franchising.
- Most raw materials purchased by *B.R.H* for manufacturing are procured from overseas suppliers, these procurement skills and connections can assist in establishing this new business venture.

#### **2. How do you ensure weaknesses will not stop you from opportunities?**

- Despite *B.R.H* having a favourable balance sheet that is indicative of the business doing well, when compared to other large established companies in the packaging industry, their financial resources is not significant enough to conduct thorough research needed to ensure a risk free entry to this new business venture. Fortunately the owner has a lot of experience and has established a number of friends in the industry that is very beneficial in overcoming this weakness.

- On expanding the business the company could employ a marketing professional to assist in properly exposing the product to the target market and devise a marketing plan for the future as well.
- The owner should restructure the business to ensure this new department is managed separately from his already existing company, this will ensure that maximum output can be achieved.

### 3. How do you use your strengths to minimise the impact of threats?

- The possible threat of labour force instability was identified, if B.R.H can translate good customer relations to good employee relations in order to build a more personal relationship with the employee this could result in them being loyal to the company.
- B.R.H can use the available space effectively and efficiently to create a productive environment in order to maximise the output and reduce the costs for the company to help compete in price wars.
- Use the personal relationships with suppliers to reduce costs of raw materials to mitigate the effect of price increase in electricity and fuel.

### 4. How will you fix weaknesses that can make threats have a real impact?

- Thorough research should be conducted before entering into the packaging industry.
- Establish standard business hierarchy and procedures in the company for better control and management.
- Use available financial resources wisely and make use of outside financial resources if needed.
- Seek consultation from marketing professionals.

## 2. Machine selection using Analytical hierarchy process

### 2.1. Evaluation criteria

The evaluation criteria will be used to rank competing machines according to their ability to satisfy each criterion in comparison to one another and the objective. This method identifies the best machine in achieving the objective. The seven evaluation criterions that'll be used are explained below:

Criteria	Description
1 Expense	This includes any expense that would be incurred in physically obtaining the machine in working condition i.e. Cost price of machine, transportation costs and installation costs.
2 Usability	How easy and user friendly the machine is to operate. This influences the training costs of staff.
3 Flexibility	This is a measure of set up time and changeover time between different products.
4 Location of supplier	How accessible is the supplier if spare parts are needed. Travelling costs associated with using the supplier.
5 Support & maintenance	Support and maintenance offered by the supplier.
6 Output rate	Production speed of the machine ( number of products per hour).
7 Man power required for the process as a whole	The number of personnel required to operate the machinery and to fold the boxes.

Table 1: Evaluation Criteria descriptions

### 2.2. Machine alternatives

In order to select a machine a number of alternatives are required. These alternatives need to be selected based on a common output requirement. As B.R.H. currently purchases four different sizes of boxes, it was decided to identify the largest of the four and to use it as a standard for further calculations. Information on these calculations can be found in Appendix E. There are eight competing machines. More information on each can be found in Appendix F. In this report they will be referred to as Machine 1 to 8.

	Name
Machine 1	ZK-Semi auto slotting Machine
Machine 2	CN401-2000 cutting machine
Machine 3	CN311-2000 rotary slotting machine
Machine 4	Cangzhou kingsun
Machine 5	The heavy duty box making machine
Machine 6	The super duty box making machine
Machine 7	HiPAK Kinetic(new)
Machine 8	HiPAK(used)

Table 2: Machine alternatives

### 2.3. AHP process

In using the AHP process, the criterion is awarded a numerical value when compared pair-wise. The following scale is used (Forman and Satty, 1991):

Intensity of importance	Definition	Explanation
1	Equal importance	Two factors contribute equally to the objective.
3	Somewhat important	Slightly favour one over the other.
5	Much more important	Strongly favour one over the other.
7	Very much more important	Very strongly favour one over the other.
9	Absolutely more important	The evidence favouring one over the other is of the highest possible validity.
2,4,6,8	Intermediate values	When compromise is needed
1/8, 1/5, 1/4	Reciprocal scale	Reciprocates the compared element in pair

Table 3: Numerical scale used in AHP

#### Step 1: Formulation of Pair-wise comparison matrix

The initial step is the formulation of a pair-wise comparison matrix of the evaluation criteria using the numerical scale above. The following results are obtained:

	Expense	Usability	Flexibility	Location of supplier	Man power required	Support & maintenance	out put rate
Expense	1	3	3	2	3	2	0.2
Usability	0.33	1	1	0.5	1	0.5	0.2
Flexibility	0.33	1	1	0.5	1	0.5	0.2
Location of supplier	0.5	2	2	1	2	1	0.2
Man power required	0.33	1	1	0.5	1	0.5	0.2
Support & maintenance	0.5	2	2	1	2	1	0.2
Output rate	5	5	5	5	5	5	1
TOTAL	7.99	15	15	10.5	15	10.5	2.2

Table 4: The pair-wise comparison matrix for evaluation criteria

#### Step 2: Formulation of the Intermediate Matrix and Calculation of criteria weights (averages)

The intermediate matrix in the table below is calculated by dividing the cells in table above by the total of each cells column.

	Expense	Usability	Flexibility	Location of supplier	Man power required	Support & maintenance	out put rate
Expense	0.13	0.2	0.2	0.19	0.2	0.19	0.09
Usability	0.04	0.07	0.07	0.05	0.07	0.05	0.09
Flexibility	0.04	0.07	0.07	0.05	0.07	0.05	0.09
Location of supplier	0.06	0.13	0.13	0.1	0.13	0.1	0.09
Man power required	0.04	0.07	0.07	0.05	0.07	0.05	0.09
Support & maintenance	0.06	0.13	0.13	0.1	0.13	0.1	0.09
Output rate	0.63	0.33	0.33	0.48	0.33	0.48	0.45

**Table 5: Intermediate matrix for the evaluation criteria**

The Importance of the criteria is represented by the weight per criteria and is calculated as the average per row. The table below ranks the criteria according to importance.

Output rate	0.43
Expense	0.17
Location of supplier	0.11
Support & maintenance	0.11
Usability	0.06
Flexibility	0.06
Man power required	0.06

**Table 6: Weight per Criteria for the evaluation criteria**

**Step 3: The calculation of the Consistency Index.**

To ensure that the AHP process returns valid results, a consistency index calculation is completed on each of the matrices used (Winston 2004). For a matrix to be consistent the CI/RI ratio must be less than 0.1. Detailed explanations of the steps to calculate the consistency index are shown in Appendix B.

The selected Machine alternatives need to be compared to each other while only considering one criterion at a time. The steps outlined above are used for the eight alternatives compared to each of the seven criteria and yield the following results:

Expense	Machine 1	Machine 2	Machine 3	Machine 4	Machine 5	Machine 6	Machine 7	Machine 8	Alternatives weights
Machine 1	1	0.25	0.5	1	7	8	9	8	0.159
Machine 2	4	1	3	4	7	8	9	8	0.344
Machine 3	2	0.33	1	2	7	8	9	8	0.204
Machine 4	1	0.25	0.5	1	7	8	9	8	0.159
Machine 5	0.14	0.14	0.14	0.14	1	3	7	2	0.053
Machine 6	0.13	0.13	0.13	0.13	0.33	1	2	0.5	0.025
Machine 7	0.11	0.11	0.11	0.11	0.14	0.5	1	0.2	0.017
Machine 8	0.13	0.13	0.13	0.13	0.5	2	5	1	0.038
<b>Total</b>	8.51	2.34	5.51	8.51	29.97	38.5	51	35.7	1

Table 7: Alternatives compared in terms of expense.

In terms of expense, it seems Machine 2 is the most economical choice, as it is under R 22 000. Machine 7 is the most expensive at R 913 466.

Flexibility	Machine 1	Machine 2	Machine 3	Machine 4	Machine 5	Machine 6	Machine 7	Machine 8	Alternatives weights
Machine 1	1	1	1	1	0.17	0.17	0.14	0.13	0.031
Machine 2	1	1	1	1	0.17	0.17	0.14	0.13	0.031
Machine 3	1	1	1	1	0.17	0.17	0.14	0.13	0.031
Machine 4	1	1	1	1	0.17	0.17	0.14	0.13	0.031
Machine 5	6	6	6	6	1	1	0.5	0.33	0.159
Machine 6	6	6	6	6	1	1	0.5	0.5	0.166
Machine 7	7	7	7	7	2	2	1	1	0.25
Machine 8	8	8	8	8	3	3	1	1	0.299
<b>Total</b>	31	31	31	31	7.68	7.68	3.56	3.35	1

Table 8 : Alternatives compared in terms of flexibility.

When considering flexibility, machine 8 will be the best option as it has the fastest changeover time of less than 30 seconds.

Usability	Machine 1	Machine 2	Machine 3	Machine 4	Machine 5	Machine 6	Machine 7	Machine 8	Alternatives weights
Machine 1	1	0.25	3	0.33	0.13	0.13	0.13	0.13	0.028
Machine 2	4	1	5	3	0.17	0.17	0.17	0.17	0.0603
Machine 3	0.33	0.2	1	3	0.11	0.11	0.11	0.11	0.0275
Machine 4	3	0.33	0.33	1	0.14	0.14	0.14	0.14	0.0307
Machine 5	8	6	9	7	1	1	1	1	0.2134
Machine 6	8	6	9	7	1	1	1	1	0.2134
Machine 7	8	6	9	7	1	1	1	1	0.2134
Machine 8	8	6	9	7	1	1	1	1	0.2134
<b>Total</b>	40.33	25.78	45.33	35.33	4.55	4.55	4.55	4.55	1

Table 9: Alternatives compared in terms of Usability.

When it comes to usability Machines 5, 6, 7, 8 have touch screens and a programme to help guide you through the box manufacturing process.

Location of supplier	Machine 1	Machine 2	Machine 3	Machine 4	Machine 5	Machine 6	Machine 7	Machine 8	Alternative weights
Machine 1	1	1	1	1	5	5	2	2	0.18
Machine 2	1	1	1	1	5	5	2	2	0.18
Machine 3	1	1	1	1	5	5	2	2	0.18
Machine 4	1	1	1	1	5	5	2	2	0.18
Machine 5	0.2	0.2	0.2	0.2	1	1	0.2	0.2	0.031
Machine 6	0.2	0.2	0.2	0.2	1	1	0.2	0.2	0.031
Machine 7	0.5	0.5	0.5	0.5	5	5	1	1	0.109
Machine 8	0.5	0.5	0.5	0.5	5	5	1	1	0.109
<b>Total</b>	5.4	5.4	5.4	5.4	32	32	10.4	10.4	1

Table 10: Alternatives compared in terms of Location of Supplier.

The location of the supplier for Machines 1, 2, 3 and 4 is in China.



Support & maintenance	Machine 1	Machine 2	Machine 3	Machine 4	Machine 5	Machine 6	Machine 7	Machine 8	Alternative weights
Machine 1	1	0.33	0.33	1	0.13	0.13	0.11	2	0.033
Machine 2	3	1	1	3	0.2	0.2	0.17	3	0.067
Machine 3	3	1	1	3	0.2	0.2	0.17	3	0.067
Machine 4	1	0.33	0.33	1	0.13	0.13	0.11	2	0.033
Machine 5	8	5	5	8	1	1	0.33	5	0.209
Machine 6	8	5	5	8	1	1	0.33	5	0.209
Machine 7	9	6	6	9	3	3	1	4	0.343
Machine 8	0.5	0.33	0.33	0.5	0.2	0.2	0.33	1	0.038
<b>Total</b>	33.5	18.99	18.99	33.5	5.86	5.86	2.55	25	1

Table 11: Alternatives compared in terms of Support & Maintenance.

The support and maintenance of machine 7 is the most advantageous as it has a 24 month warranty which includes free repairs for that period of time.

Output rate	Machine 1	Machine 2	Machine 3	Machine 4	Machine 5	Machine 6	Machine 7	Machine 8	Alternative criteria
Machine 1	1	5	5	5	9	9	8	8	0.4026
Machine 2	0.2	1	1	1	7	7	6	6	0.1507
Machine 3	0.2	1	1	1	7	7	6	6	0.1507
Machine 4	0.2	1	1	1	7	7	6	6	0.1507
Machine 5	0.11	0.14	0.14	0.14	1	0.5	0.2	0.2	0.0189
Machine 6	0.11	0.14	0.14	0.14	2	1	0.25	0.25	0.0239
Machine 7	0.13	0.17	0.17	0.17	5	4	1	1	0.0512
Machine 8	0.13	0.17	0.17	0.17	5	4	1	1	0.0512
<b>Total</b>	2.08	8.62	8.62	8.62	43	39.5	28.45	28.45	1

Table 12: Alternatives compared in terms of Output rate.

The alternative with the highest output rate is Machine 1 of 4 200 boxes/hour.

Man power required	Machine 1	Machine 2	Machine 3	Machine 4	Machine 5	Machine 6	Machine 7	Machine 8	Alternative weights
Machine 1	1	1	0.2	7	0.2	0.2	0.14	0.14	0.0424
Machine 2	1	1	0.2	7	0.2	0.2	0.14	0.14	0.0424
Machine 3	5	5	1	7	1	1	0.33	0.33	0.1201
Machine 4	0.14	0.14	0.14	1	0.14	0.14	0.11	0.11	0.0171
Machine 5	5	5	1	7	1	1	0.33	0.33	0.1201
Machine 6	5	5	1	7	1	1	0.33	0.33	0.1201
Machine 7	7	7	3	9	3	3	1	1	0.2689
Machine 8	7	7	3	9	3	3	1	1	0.2689
<b>Total</b>	31.14	31.14	9.54	54	9.54	9.54	3.38	3.38	<b>1</b>

Table 13: Alternatives compared in terms of Man power required for the whole process.

The alternatives that requires the least man power for the entire system is Machines 7 and 8. The machine has an automatic feeder, therefore only one employee is required to fold the boxes.

The consistency index calculation for each of the preceding tables can be found in the Appendix B. All the matrices went through these steps and show their CI/RI values are less than 0.1. The AHP results and calculations are thus valid.

#### 2.4. Final result

The final score for each alternative is calculated and the highest score is the best alternative, according to the AHP. The calculation of this AHP result can be explained in the diagram below, Figure 10.

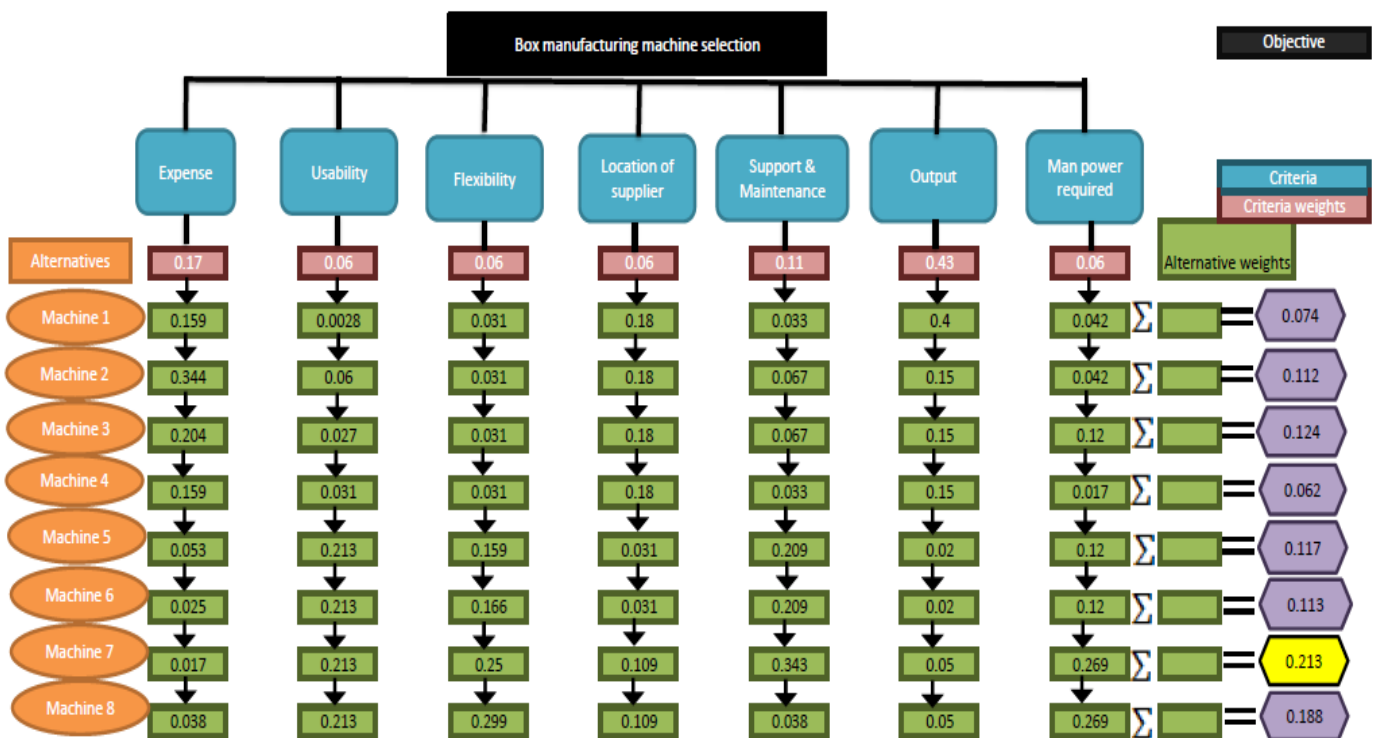


Figure 10: AHP results describing criteria and alternatives.

The weight per criteria, red blocks, are multiplied by the score awarded to each alternative when considering the criteria only, shown in the green blocks. These multiplications are summed for each alternative and the final results of the alternative are shown in the hexagons. The yellow hexagon indicates that Machine 7 is the best alternative; with the percentage of 21.3%. Machine 8 follows with a percentage of 18.8% and Machines 5, 6, 2 are relatively close with 11.7%, 11.3%, and 11.2% respectively. Far behind are Machines 1 and 4.

### 3. Cost classification

Cost classifications for the manufacturing of packaging material as identified in the literature review above, are as follows:

- Start-up costs are all the non-recurring costs associated with the start-up of the business. In this instance it is the price of purchasing the machine. This cost includes the installation and training of staff by an *Autobox* approved engineer. As this is the only start-up cost a 10% miscellaneous cost item will be added to the total.
- Fixed monthly costs are all costs that remain constant, in total, regardless of the changes in level of activity. In this instance they were identified as maintenance and insurance costs.
- Variable costs are all costs that vary, in total, in direct proportion to changes in level of activity. In this instance they were identified as direct labour, direct materials; tape, corrugated cardboard sheets and electricity.
- Non-manufacturing costs will not be included as the procurement department who orders the manufactured boxes will be doing the administration of the box manufacturing department now.

Data relating to each of these costs were gathered from quotations from a number of companies. A summary of these quotations can be viewed in appendix C.

### 4. Phase 1: Cost analysis for the manufacturing to use only

#### 4.1. Monte Carlo simulation for total monthly costs

*B.R.H.* requires 60 000 boxes monthly for packaging. The calculation of the total monthly costs; fixed and variable costs, for the manufacturing of 60 000 boxes can be found in appendix D.

A Monte Carlo simulation was conducted using 1 100 iterations, to determine the expected total monthly costs of the manufacturing of 60 000 cardboard boxes (500 of these iterations can be found in appendix G). The following results were observed:

- ✓ 0% we have a total cost of less than current monthly outsourcing cost of R366 213.20 (calculated in table 14)
- ✓ 4.1% we have a total cost of less than R500 000.
- ✓ 56.81% we have a total cost of less than R1 100 000.
- ✓ 39.27% we have a total cost in the range of R1 100 000 – R1 500 000.

There are three possible values for total monthly variable costs; optimistic, realistic and pessimistic, as can be seen in the table below:

	Minimum	Average	Maximum
<b>Total monthly variable costs</b>	<b>R403 762.43</b>	<b>R1 010 944.59</b>	<b>R1 586 863.69</b>
<b>Variable cost (R/unit)</b>	<b>R 6.73</b>	<b>R 16.85</b>	<b>R 26.45</b>
	<b>Optimistic</b>	<b>Realistic</b>	<b>Pessimistic</b>

**Table 14: The three possible values for total monthly costs; optimistic, realistic and pessimistic.**

#### 4.2. Break-even analysis

A break-even analysis is conducted to compare each possible variable cost outcome; optimistic, realistic and pessimistic against the current outsourcing cost per month.

A start-up cost of R100 4812.6 is added in under fixed costs (This calculation can be found in appendix D)

The current monthly outsourcing costs:

Monthly cost	
Ready made boxes(with 14% vat)	R350 413.20
Tape	R10 800
Labour	R5000
<b>Total</b>	<b>R366 213.20</b>

Table 15: Calculation of total monthly outsourcing cost for 60 000boxes

When this monthly outsourcing cost is plotted against the optimistic, realistic and pessimistic costs for in-house manufacturing alternative the following result is obtained:

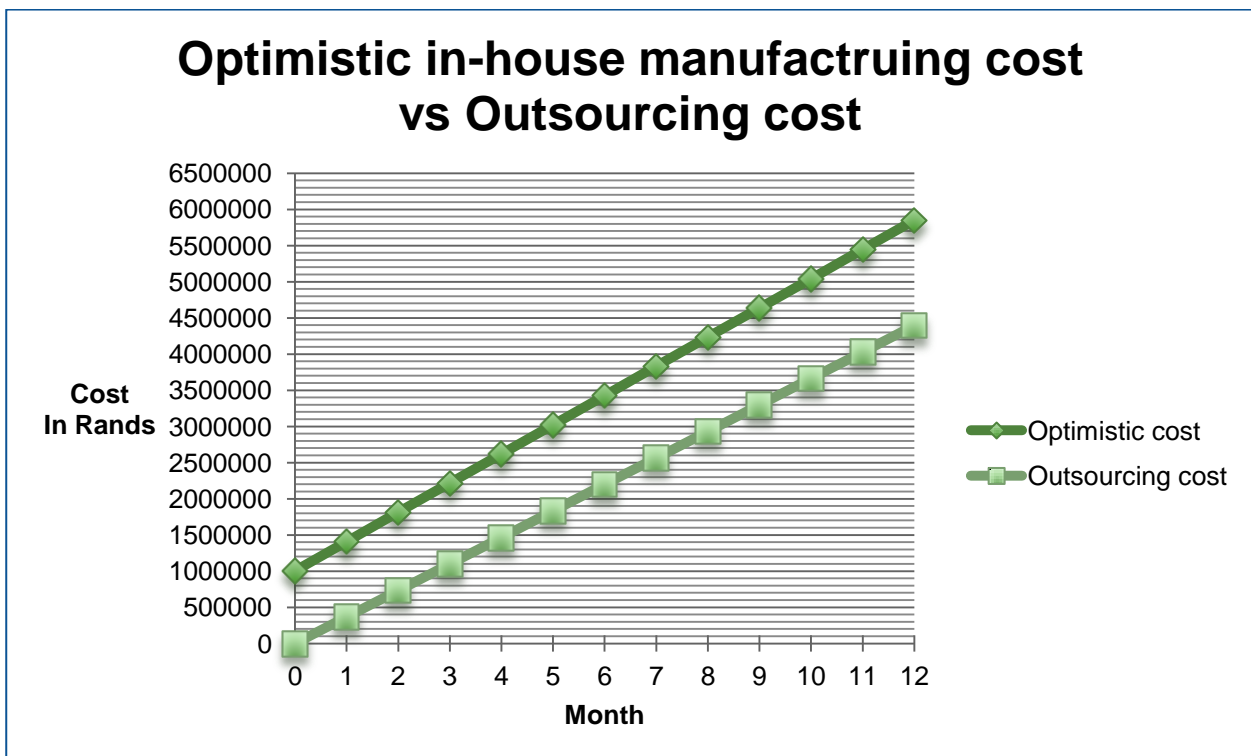


Figure 11: This graph illustrates the optimistic monthly in-house manufacturing cost against the outsourcing cost of 60 000 cardboard boxes.

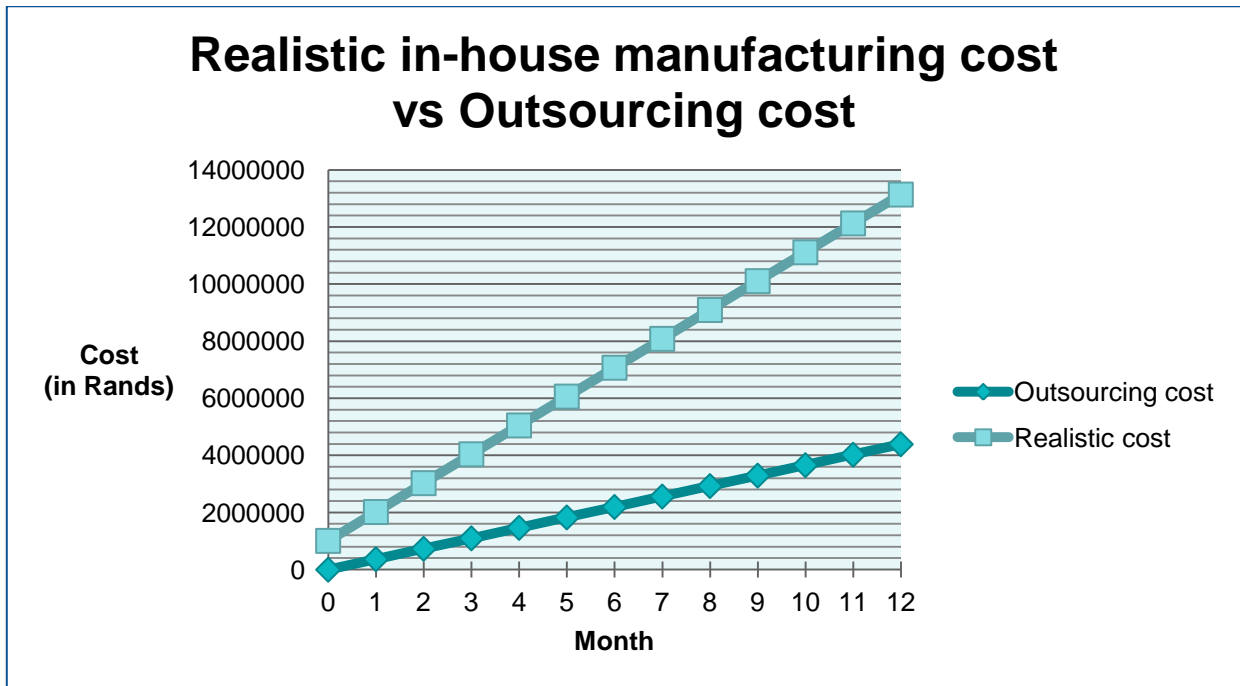


Figure 12: This illustrates the realistic monthly in-house manufacturing cost against the outsourcing cost of 60000 cardboard boxes.

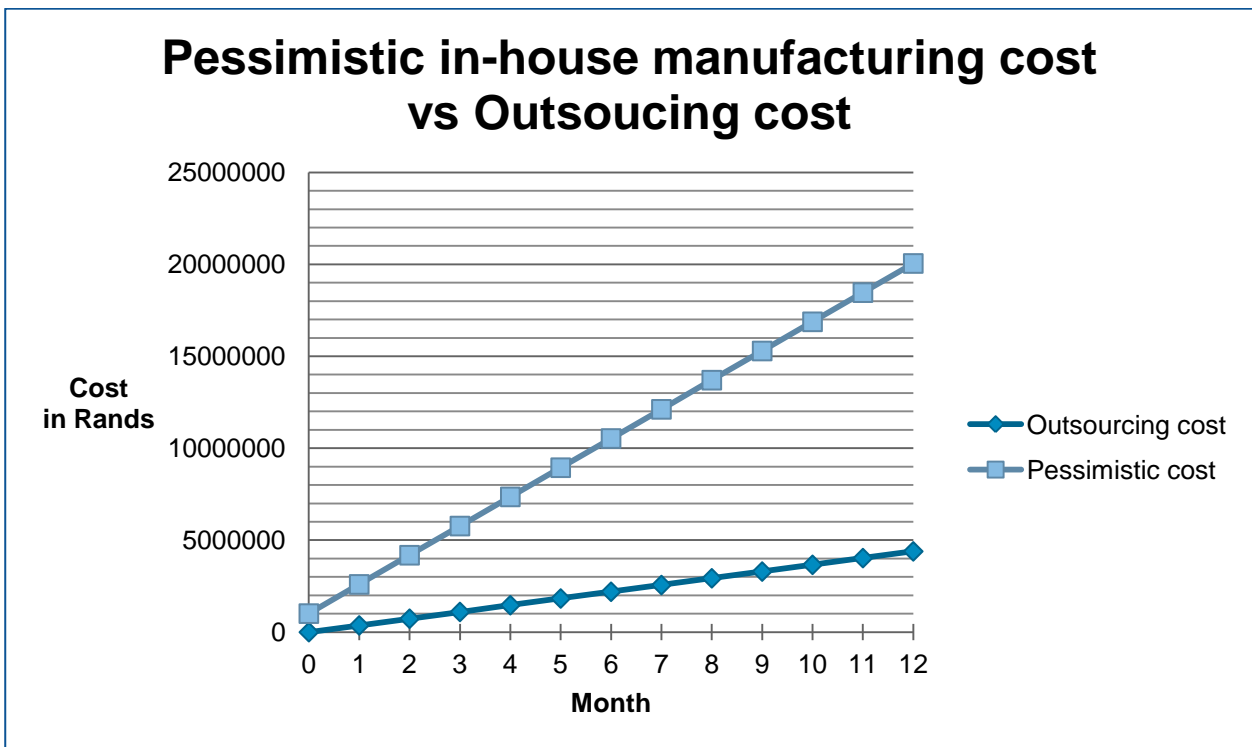


Figure 13: This graph illustrates the pessimistic monthly in-house manufacturing cost against the outsourcing cost of 60 000 cardboard boxes.

#### 4.3. Analysis of Phase 1

The difference between the optimistic in-house manufacturing cost and outsourcing cost of the cardboard boxes is relatively small this can be seen in Figure 11. The other two graphs, Figure 12 and 13 show a large difference in the realistic and pessimistic in-house manufacturing costs compared to the outsourcing cost. This cost analysis indicates that the outsourcing of 60 000 cardboard boxes is much lower than in-house manufacturing. However the machine only operates at 37.5% capacity. If this is increased the extra boxes produced can be sold for income, which could reduce expenses. This is explored in Phase 2.

## 5. Phase 2: The cost analysis for the manufacturing of boxes to use and sell

### 5.1. Monte Carlo simulation

The machine operates at 37.5% capacity to produce what the company requires; 60 000 cardboard boxes. If the machines capacity is increased to 75%, all the extra cardboard boxes will be sold at the company's mark-up price of 40%.

A Monte Carlo simulation for 1100 iterations was conducted for the calculation of total variable costs of the production of 120 000 boxes less the sale of 60 000 (494 of these iterations can be found in appendix H). The following results was observed:

- ✓ 51.27% of the time we can expect an expense of less than R366 213.20(current total outsourcing cost).
- ✓ 44.36% of the time we can expect an expense of less than R50 000.
- ✓ 43.64% of the time we can expect to turn a profit (negative expense).

### 5.2. Break-even analysis

A break-even analysis is conducted to compare each possible total variable cost; optimistic, realistic and pessimistic, against the outsourcing costs.

When this monthly outsourcing cost is plotted against the optimistic, realistic and pessimistic total monthly costs for in-house manufacturing alternative, the following results are obtained:

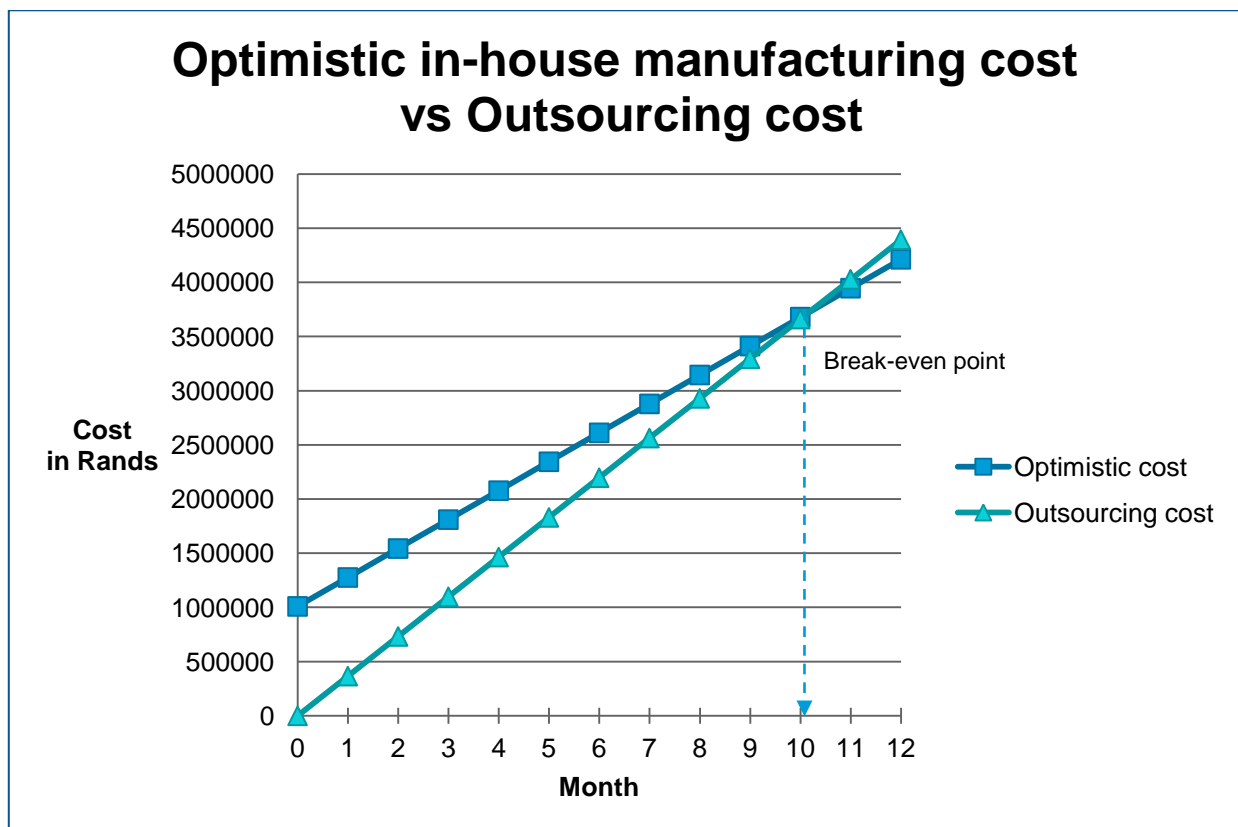


Figure 14: This graph illustrates the optimistic total monthly in-house manufacturing cost, including the income from the sale of extra boxes, against the outsourcing cost.

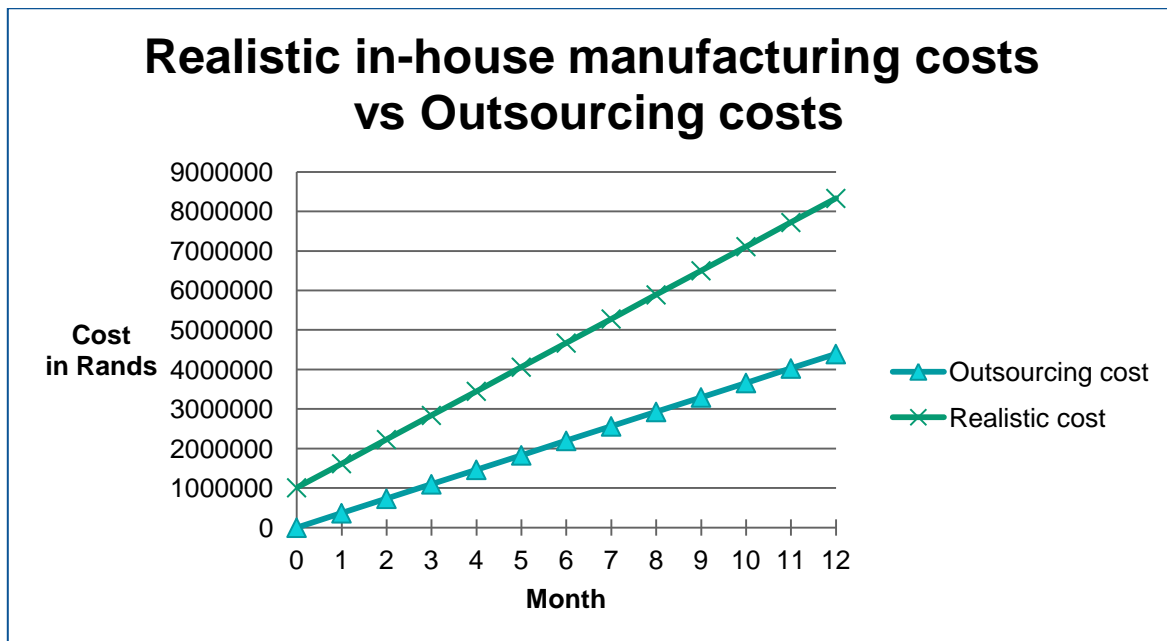


Figure 15: This graph illustrates the realistic total monthly in-house manufacturing cost, including the income from the sale of extra boxes, against the outsourcing cost.

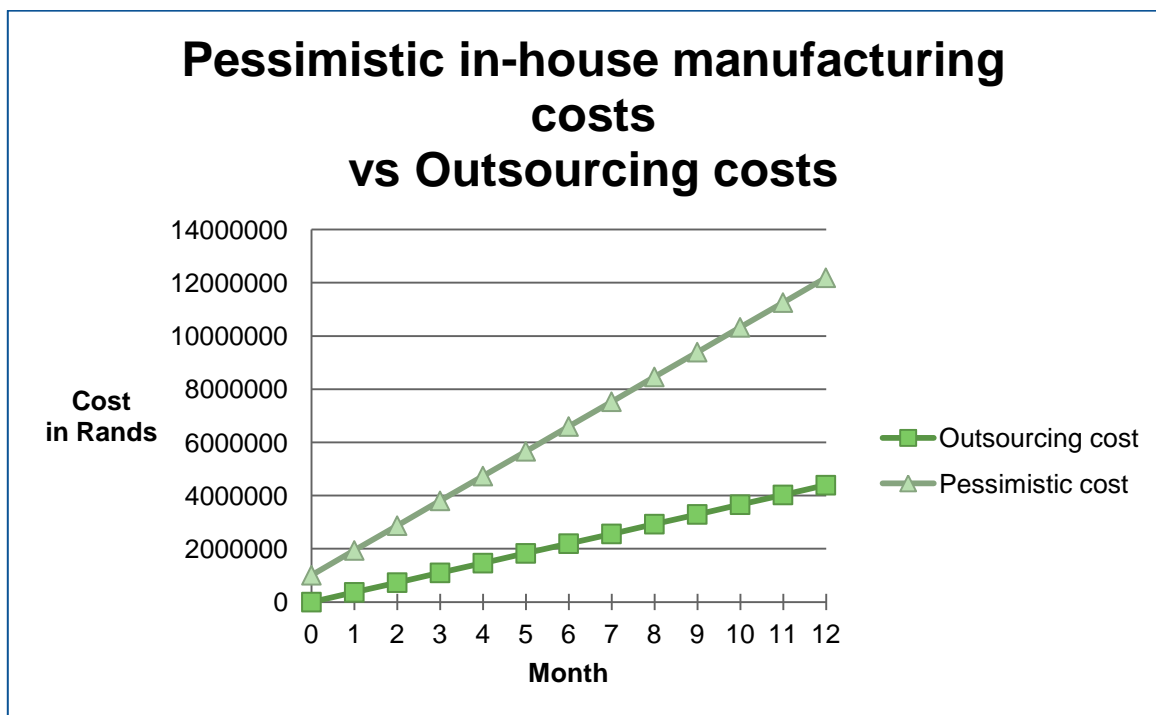


Figure 16: This graph illustrates the realistic total monthly in-house manufacturing cost, including the income of the sale of extra boxes, against the outsourcing cost.

### 5.3. Analysis

Figure 14 identifies that costs will break even after 10 months. This is if optimistic total monthly costs are achieved and all extra boxes are sold. Whereas the other two graphs, realistic and pessimistic, the outsourcing cost is still significantly smaller.

## Chapter 4

### 1. Conclusion

The Swot analysis concludes that the business has a number of strengths that are unique to a family style business which can be used to attain a number of opportunities, including the expansion of the business to the packaging industry. This ensures that the business has the capability, if appropriate procedures are put into place, for this new venture to be successful.

The Analytical Hierarchy Process further suggests that the *Autobox HiPak Kinetic* (Machine 7) be selected with 21.3% certainty. The validation of the AHP gives the decision makers the assurance of a trustworthy result.

The cost analysis in the first phase, on the other hand, does not give a favourable outcome as the outsourcing cost is lower than all possible in-house manufacturing costs. Due to this it was decided to investigate if the sale of extra cardboard boxes would reduce monthly manufacturing costs. In the second phase the machines capacity was increased from 37.5% to 75%, where 60 000 extra boxes were sold at a 40% mark-up price. Costs broke even after 10 months, using optimistic manufacturing costs.

### 2. Recommendation

In light of the stated results of this project, the owner of *B.R.H.* is advised to remain with his current sourcing strategy for cardboard boxes. This is due to the fact that the in-house manufacturing of boxes for their own use is too expensive.

While increasing the production to sell excess cardboard boxes is an option, the selling of all extra boxes is unrealistic. The company cannot base the success of this new business venture on external customers which do not exist yet.

All results identify that the in-house manufacturing of cardboard boxes is infeasible and will not provide a new business venture for *B.R.H. (PTY.LTD.)*.



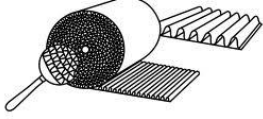
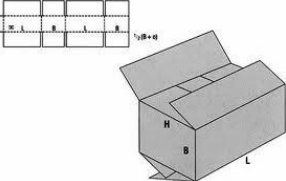
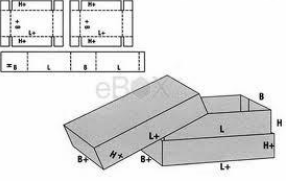
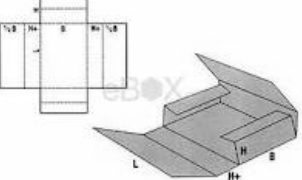
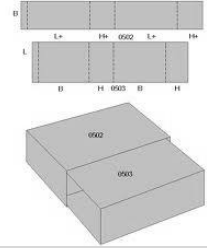
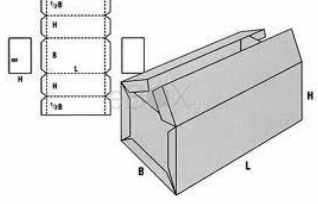
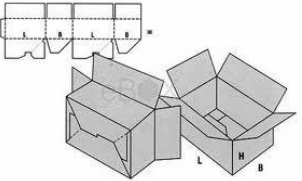
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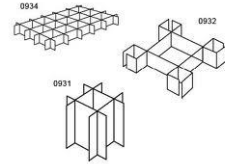
# Appendix

## Appendix A: Cardboard box information

### 1. FEFCO Box styles

Category	Name	Description	Examples
01	Commercial sheets & rolls	<ul style="list-style-type: none"> <li>Single Face corrugated roll and</li> <li>Single wall Corrugated sheets (also known as double faced).</li> </ul>	
02	Slotted type boxes	<ul style="list-style-type: none"> <li>One piece of board with a glued, stitched or taped manufacturer joint.</li> <li>Top and bottom flaps.</li> </ul>	
03	Telescope type boxes	<ul style="list-style-type: none"> <li>More than one piece of board.</li> <li>lid and/or bottom telescoping over the body of the box.</li> </ul>	
04	Folder type boxes & trays	<ul style="list-style-type: none"> <li>One piece of board</li> <li>Bottom of the box is hinged to form two or all side walls and the cover.</li> <li>Locking tabs, handles, display panels etc., can be incorporated in some designs.</li> </ul>	
05	Slide-type boxes	<ul style="list-style-type: none"> <li>A number of liners and sleeves sliding in different direction in into each other.</li> <li>This group includes outside sleeves for other cases.</li> </ul>	
06	Rigid-type boxes	<ul style="list-style-type: none"> <li>Two separate end pieces and a body</li> <li>Requires stitching or similar operation before they can be used.</li> </ul>	
07	Dye glued cases	<ul style="list-style-type: none"> <li>One piece of board</li> <li>simple to set up.</li> </ul>	

- This includes inside liners, pads, partitions, dividers etc, whether tied to Case Design or as a singular piece.



## 2. Cardboard flute sizes

	Description
<b>A-flute</b>	The original flute and has the highest arch height. Excellent stiffness and short column crush resistance and is most widely used for cushioning properties.
<b>B-flute</b>	Good all round compression strength, compactness, printability and cost effectiveness. Also handles complex die cuts very well.
<b>C-flute</b>	Larger than B smaller than B. It is by far most commonly used flute type with as estimated 80% of the worlds containers made of C flute cardboard. Although it has greater compression strength but can be more easily crushed.
<b>E-flute</b>	Fine flute that provides excellent crush resistance and printability
<b>F-flute</b>	Is just over half the thickness of the E-flute. It is the newest addition to that packaging industry and offers the lowest fibre content of all the other flutes.
<b>BC-flute</b>	[Double wall]: combination of B and C flutes offers greatest compression and stacking strength.
<b>EB-flute</b>	[Double wall]: the combination of E and B flute with the crush resistance of the E flute with excellent printability. It takes up less space than the EB profile.
<b>BF-flute</b>	[Double wall]: very strong crush resistance and rigidity as well as excellent printability. It has the lowest combined fibre content of all the double wall profiles yet remains one of the most expensive.



## Appendix B: AHP calculations

### 1. CI calculations

The following steps will be followed to calculate CI for Pair-wise comparison of criteria.

1. Calculate Matrix AW

Pair-wise Comparison Matrix A (Table 5) x Weight Matrix W (Table 6) = Matrix AW

2. Calculate CI

$$CI = \frac{\frac{1}{n} \sum_{i=1}^n \frac{(AW)_i}{W_i - n}}{n-1} \quad n = \text{Number of Criteria}$$

3. Calculate  $\frac{CI}{RI}$

The values of Random Index (RI) are set values for each amount of n. It gives the average values of CI, if the entries in A are randomly chosen. However it is required that all diagonal values equal one and for all other values:  $a_{ij} = \frac{1}{a_{ji}}$ .

For an acceptable consistency  $\frac{CI}{RI} < 0.1$  and for a perfectly consistent decision maker  $\frac{CI}{RI} = 0$ .

n	2	3	4	5	6	7	8	9	10
RI	0	0.58	0.9	1.12	1.24	1.32	1.41	1.45	1.51

For the Evaluation Criteria pair-wise comparison from the table above:

n=7 has a RI= 1.32

and from the equation : CI=0.0272.

Therefore  $\frac{CI}{RI} = 0$ .

Meaning a perfectly consistent decision maker is used.



Usability	Machine 1	Machine 2	Machine 3	Machine 4	Machine 5	Machine 6	Machine 7	Machine 8	Intermediate matrix								Criteria weight	AW				
	Machine 1	Machine 2	Machine 3	Machine 4	Machine 5	Machine 6	Machine 7	Machine 8														
Machine 1	1	0.25	3	0.33	0.13	0.13	0.13	0.13	0.0248	0.0097	0.0662	0.0093	0.0286	0.0286	0.0286	0.029	0.028	0.25				
Machine 2	4	1	5	3	0.17	0.17	0.17	0.17	0.0992	0.0388	0.1103	0.0849	0.0374	0.0374	0.0374	0.037	0.0603	0.55				
Machine 3	0.33	0.2	1	3	0.11	0.11	0.11	0.11	0.0082	0.0078	0.0221	0.0849	0.0242	0.0242	0.0242	0.024	0.0275	0.23				
Machine 4	3	0.33	0.33	1	0.14	0.14	0.14	0.14	0.0744	0.0128	0.0073	0.0283	0.0308	0.0308	0.0308	0.031	0.0307	0.26				
Machine 5	8	6	9	7	1	1	1	1	0.1984	0.2327	0.1985	0.1981	0.2198	0.2198	0.2198	0.22	0.2134	1.9				
Machine 6	8	6	9	7	1	1	1	1	0.1984	0.2327	0.1985	0.1981	0.2198	0.2198	0.2198	0.22	0.2134	1.9				
Machine 7	8	6	9	7	1	1	1	1	0.1984	0.2327	0.1985	0.1981	0.2198	0.2198	0.2198	0.22	0.2134	1.9				
Machine 8	8	6	9	7	1	1	1	1	0.1984	0.2327	0.1985	0.1981	0.2198	0.2198	0.2198	0.22	0.2134	1.9				
Total	31	31	31	31	7.68	7.68	3.56	3.35														
																	CI=0.027977	=0.019842	acceptable			
																	W	AW	RI= 1.41	n=8		

Location of supplier	Machine 1	Machine 2	Machine 3	Machine 4	Machine 5	Machine 6	Machine 7	Machine 8	Intermediate matrix								Criteria weight	AW				
	Machine 1	Machine 2	Machine 3	Machine 4	Machine 5	Machine 6	Machine 7	Machine 8														
Machine 1	1	1	1	1	5	5	2	2	0.1852	0.1852	0.1852	0.1852	0.1563	0.1563	0.1923	0.192	0.18	1.47				
Machine 2	1	1	1	1	5	5	2	2	0.1852	0.1852	0.1852	0.1852	0.1563	0.1563	0.1923	0.192	0.18	1.47				
Machine 3	1	1	1	1	5	5	2	2	0.1852	0.1852	0.1852	0.1852	0.1563	0.1563	0.1923	0.192	0.18	1.47				
Machine 4	1	1	1	1	5	5	2	2	0.1852	0.1852	0.1852	0.1852	0.1563	0.1563	0.1923	0.192	0.18	1.47				
Machine 5	0.2	0.2	0.2	0.2	1	1	0.2	0.2	0.037	0.037	0.037	0.037	0.0313	0.0313	0.0192	0.019	0.031	0.25				
Machine 6	0.2	0.2	0.2	0.2	1	1	0.2	0.2	0.037	0.037	0.037	0.037	0.0313	0.0313	0.0192	0.019	0.031	0.25				
Machine 7	0.5	0.5	0.5	0.5	5	5	1	1	0.0926	0.0926	0.0926	0.0926	0.1563	0.1563	0.0962	0.096	0.109	0.89				
Machine 8	0.5	0.5	0.5	0.5	5	5	1	1	0.0926	0.0926	0.0926	0.0926	0.1563	0.1563	0.0962	0.096	0.109	0.89				
Total	5.4	5.4	5.4	5.4	32	32	10.4	10.4														
																	CI=0.017403	=0.012343	acceptable			
																	W	AW	RI= 1.41	n=8		

Support & maintenance	Machine 1	Machine 2	Machine 3	Machine 4	Machine 5	Machine 6	Machine 7	Machine 8	Intermediate matrix								Criteria weight	AW				
	Machine 1	Machine 2	Machine 3	Machine 4	Machine 5	Machine 6	Machine 7	Machine 8														
Machine 1	1	0.33	0.33	1	0.13	0.13	0.11	2	0.0299	0.0174	0.0174	0.0299	0.0222	0.0222	0.0431	0.08	0.033	0.28				
Machine 2	3	1	1	3	0.2	0.2	0.17	3	0.0896	0.0527	0.0527	0.0896	0.0341	0.0341	0.0667	0.12	0.067	0.59				
Machine 3	3	1	1	3	0.2	0.2	0.17	3	0.0896	0.0527	0.0527	0.0896	0.0341	0.0341	0.0667	0.12	0.067	0.59				
Machine 4	1	0.33	0.33	1	0.13	0.13	0.11	2	0.0299	0.0174	0.0174	0.0299	0.0222	0.0222	0.0431	0.08	0.033	0.28				
Machine 5	8	5	5	8	1	1	0.33	5	0.2388	0.2633	0.2633	0.2388	0.1706	0.1706	0.1294	0.2	0.209	1.92				
Machine 6	8	5	5	8	1	1	0.33	5	0.2388	0.2633	0.2633	0.2388	0.1706	0.1706	0.1294	0.2	0.209	1.92				
Machine 7	9	6	6	9	3	3	1	4	0.2687	0.316	0.316	0.2687	0.5119	0.5119	0.3922	0.16	0.343	3.15				
Machine 8	0.5	0.33	0.33	0.5	0.2	0.2	0.33	1	0.0149	0.0174	0.0174	0.0149	0.0341	0.0341	0.1294	0.04	0.038	0.31				
Total	33.5	18.99	18.99	33.5	5.86	5.86	2.55	25														
																	CI=0.110121	RI=0.0781	acceptable			
																	W	AW	RI= 1.41	n=8		





## Appendix C: Data for cost analysis – Quotations

### 1. Electricity rates

According to Eskom's Tariffs & Charges booklet for 2011/2012:

Block structure	2011/12 block rates(c/kWh)	R/kWh
Block 1	60.83	0.61
Block 2	75.09	0.75
Block 3	111.42	1.11
Block 4	122.21	1.22

### 2. Labour rates

According to Western Cape government survey across all 9 provinces source:

<http://www.westerncape.gov.za/eng/pubs/guides/C/17563/#LabouRT>

	Lower skilled labour rates(R/h)		Semi-Skilled labour rates(R/h)	
	Basic package	Total package	Basic package	Total package
Kwa-Zulu Natal	12.52	17.52	18.54	25.67
Gauteng	12.9	18.05	19.72	26.17
Western Cape	12.02	16.55	17.99	24.63
Eastern Cape	11.89	16.71	17.95	24.38
Mpumalanga	11.92	16.67	17.25	24.86
Northern Cape	10.95	15.71	16.88	23.09
Northern Province	12.77	15.84	17.41	23.65
North West	11.17	15.63	16.86	27.75
Free State	11.11	15.81	18.16	23.83

### 3. Tape quotes

Source: <http://www.tape-market.co.za/html/products.html#packtape>

Source: [http://solutions.3m.com/wps/portal/3M/en\\_US/Manufacturing/Industry/Product-Catalog/Online-Catalog/?PC\\_7\\_RJH9U5230GE3E02LECFTDQGLE0000000\\_nid=FL96CT7037beTRGGC52N4Mgl](http://solutions.3m.com/wps/portal/3M/en_US/Manufacturing/Industry/Product-Catalog/Online-Catalog/?PC_7_RJH9U5230GE3E02LECFTDQGLE0000000_nid=FL96CT7037beTRGGC52N4Mgl)

	Supplier	Description	Size	Price/roll
1	THE TAPE MARKET	Packaging tape BOPP, buff and clear	48mm x 50m	R 5.50
2	CURRENT SUPPLIER	Packaging tape	48mm x 50m	R 7.50
3	SHOP 3M	Scotch box sealing tape 373 clear	48mm x 1500m	R 1 220.03
4	HILLAS PACKAGING	Scotch box sealing tape 373 clear	48mm x 1500m	R 975.99
5	H.R.S HUGHES	Scotch box sealing tape 373 clear	48mm x 1500m	R 1 435.33
6	FASTENAL	Scotch box sealing tape 373 clear	48mm x 1500m	R 1 870.71
7	APD MRO.COM	Scotch box sealing tape 373 clear	48mm x 1500m	R 2 745.09
8	COLONY PAPERS	Scotch box sealing tape 373 clear	48mm x 1500m	R 1 347.69
9	BELSON CO.	Scotch box sealing tape 373 clear	48mm x	R 1



			1500m	466.05
10	DIVERSIFIED PACKAGING CORP	Scotch box sealing tape 373 clear	48mm x 1500m	R 1 517.16
11	IPC	Scotch box sealing tape 373 clear	48mm x 1500m	R 1 570.96

#### 4. Cardboard sheet quotes

	Supplier	Description	Price per sheet
1	Technopad	C-flute 1842mm x 607mm	R 6.02
2	Technopad	C-flute 1842mm x 607mm	R 7.40
3	Technopad	C-flute 1842mm x 607mm	R 8.25
4	Mr boxline	C-flute 1842mm x 607mm	R 19.44
5	Taihou Forest Color printing packaging	C-flute 1842mm x 607mm	R 24.21
6	Boxlee	C-flute 1842mm x 607mm	R 15
7	Boxlee	C-flute 1842mm x 607mm	R 20

#### 5. Maintenance costs

For the Autobox HiPak Kinetic :

In terms of servicing, depending on usage we'd say that the machines should be serviced approx every 8 - 12 months. It's difficult to be exact on cost but if you were to budget on the following annual figures it won't be far out: (exchange rate used:€1=R10.31)

	Parts		Labour	
	Euros	Rands	Euros	Rands
<b>HiPAK Kinetic 2600 AF</b>	€700	R7217	€750	R7732.5
<b>HiCUT 2600</b>	€700	R7217	€750	R7732.5
<b>HiFEED €200</b>	€200	R2062	€200	R2062
<b>HiFLEX 300 x 500</b>	€200	R2062	€200	R2062
<b>HiFLEX 1000 x 1300 mm</b>	€200	R2062	€200	R2062
<b>HiPrint 1000 x 70</b>	€300	R3093	€300	R3093
<b>Exit Stacking System</b>	€0		€0	

## Appendix D: Calculations for cost analysis

### 1. Fixed costs

<b>Start-up costs</b>		
Purchase price of machine *	913466	
Plus add 10% for in case	91346.6	
Total start-up costs	-	<u>1004813</u>
<b>Manufacturing overhead</b>		
Maintenance	1308.08	
Insurance	3600	
Total manufacturing overhead		<u>4908.08</u>
<b>Total fixed costs</b>		<b><u>1009721.08</u></b>

\* Purchase price includes installation fees and training fees

### 2. Tape costs

Tape						
	Price/roll(in rands)	Length of each roll(m)	Total metres needed per month*	Number of rolls required#	Total cost (Rands)	Price /roll x Number of rolls required
1	5.5	50	7200	1440	7920	
2	7.5	50	7200	1440	10800	
3	1220.03	1500	7200	48	58561.44	
4	975.99	1500	7200	48	46847.52	
5	1435.33	1500	7200	48	68895.84	
6	1870.71	1500	7200	48	89794.08	
7	2745.09	1500	7200	48	131764.32	
8	1347.69	1500	7200	48	64689.12	
9	1466.05	1500	7200	48	70370.4	
10	1517.16	1500	7200	48	72823.6	
11	1570.96	1500	7200	48	75406.08	
12	13.23	50.8	7200	1417	18746.91	
13	7.99	50.8	7200	1417	11321.83	
14	2.45	76.2	7200	945	2324.7	
				<b>Minimum</b>	<b>2324.7</b>	
				<b>Average</b>	<b>52161.85</b>	
				<b>Maximum</b>	<b>131764.3</b>	

\*Number of metres used per box(1.2m) x 60 000  
#Total metres needed per month / Length of each roll

### 3. Cardboard sheet costs

Cardboard sheets				
	Price/sheet (rands)	Number of boxes per month	Total cost	Price/sheet x Number of boxes per month
1	19.44	60 000	1166400	
2	24.21	60 000	1452600	
3	15	60 000	900000	
4	20	60 000	1200000	
5	6.2	60 000	372000	
6	7.4	60 000	444000	
7	8.25	60 000	495000	
<b>Min</b>	6.2	60 000	<b>372000</b>	
<b>Average</b>	14.36	60 000	<b>861428.5714</b>	
<b>Max</b>	24.21	60 000	<b>1452600</b>	

#### 4. Electricity costs

##### Number of machine hours required

Production speed (number of boxes per hour)	1000	
Number of machine hours required	60	Number of boxes manufactured per month / Production speed

##### Kilowatt-hours per month

Machine voltage	415	
Machine current(amps)	8	
Power rating(watts)	3320	Machine voltage x Machine current
Watt-hours per month	199200	Power rating x Number of machine hours
Kilowatt-hours per month	199.2	Watt-hours per month / 1000

##### Total Rands per month

Block structure	2011/12 block rates(c/kWh)	R/kWh	Total costs per month*	*(R/kWh x Kilowatt-hours per month)
Block 1	60.83	0.61	121.51	
Block 2	75.09	0.75	149.4	
Block 3	111.42	1.11	221.11	
Block 4	122.21	1.22	243.02	
		Min	121.51	
		Average	183.76	
		Max	243.02	

#### 5. Direct labour costs

##### Folding time

Time to fold in month (in hours)	750
Time in a month available (in hours)	160
Productive hours in a month (@ 80%)	123
Number of employees required to fold	5
Number of employees required to operate machine	1

(Folding time per box x Number of boxes) / 60 min

8 hours in working day x 5 days x 4 weeks

Time in month available \* 0.80

Time to fold in month / Productive hours in month

##### Labour rates


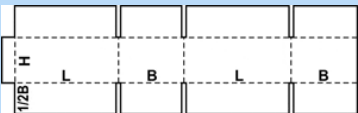
	Lower skilled labour rates(R/h)		Semi-Skilled labour rates(R/h)	
	Basic package	Total package	Basic package	Total package
	12.52	17.52	18.54	25.67
	12.9	18.05	19.72	26.17
	12.02	16.55	17.99	24.63
	11.89	16.71	17.95	24.38
	11.92	16.67	17.25	24.86
	10.95	15.71	16.88	23.09
	12.77	15.84	17.41	23.65
	11.17	15.63	16.86	27.75
	11.11	15.81	18.16	23.83
<b>Min</b>	10.95		16.86	
<b>Average</b>	14.21		21.38	
<b>Max</b>	18.05		27.75	

	Lower skilled *	Semi-skilled #	Total cost
<b>Minimum</b>	8750	2697.6	11447.6
<b>Average</b>	11368	3420.8	14788.8
<b>Maximum</b>	14440	4440	18880

\* Number of employees required to fold x (min/max/average)lower skilled labour rates

# Number of employees required to operate machine x (min/max/average)Semi-skilled labour rates

## Appendix E: Box style used to be manufactured

Type of material:	Single wall Corrugated cardboard C-flute		
Regular slotted container:			FEFCO F0201
1 mm =			0.03937inches

Box Sizes	L		B		H		Cardboard Length		Cardboard width	
	units	mm	inches	mm	inches	mm	inches	mm	inches	mm
1	540	21	365	14	150	6	1842	73	515	20
2	455	18	347	14	260	10	1636	64	607	24
3	400	16	285	11	250	10	1402	55	535	21
4	350	14	255	10	215	8	1242	49	470	19

Required size of board		inches	mm	Round off
	length=	73	1842	1.9m
	width=	24	607	650mm

The size of cardboard each box will need is 1.9m x 650mm, Single wall corrugated cardboard C-flute.

## Appendix F: Machine quotes

### 1. Machine 1: ZK-Semi auto slotting Machine



#### Use and Characteristics:

ZK series slotting machine is combination equipment, it can perform slotting, slitting, creasing one time, Its main characteristics of hand feeding single cardboard.

#### Technical parameter:

Size	2000mm
Max. Cardboard Size	2000×1000mm
Min. Cardboard Size	500X250mm
Speed	0-70pieces/min= 4200 pieces/hour
FOB Price china: USD9,600 = R77472 (manual adjustment knives)	

- Delivery time: 40 days, Offer valid: 20days
- Quotation date: 13-08-2012
- CE Certificate
- Guarantee: one year
- Exchange rate used 1 USD= R8.07

## 2. Machine 2: CN401-2000 cutting machine

**CHAOYUE**

**ORIGINAL**

### Dongguan liaobu chaoyue carton Machine business departme

Address:Shangtun Industrial area, Liaobu Town Dongguan City, Guangdong Province, China

Tel: 86-15899924182 86-769-83289801 Fax: 86-769-82873557 Email: chaoyue03@cy0769.cn


Address: South Africa

Date: 14-Aug-2012

Contact: Ms. dheevashni padayachy

mail:dee2508@gmail.com

Port of Destination: Shenzhen, China

Picture	Description of Goods	Quantity (set)	Unit Price	Amount (USD)	
CN401-2000	<b>EXW</b>				
	1.max wide size of paper:1900mm. 2.min wide size of cutting:60mm. 3.number of blades: 6set. 4.Pressure line wheels:8set. 5.Overall dimensions:2250×1170×1500mm	1	US\$2,625.00	USD\$2,625.00	

Total cost: R21 183.75

#### Payment & shipping Terms:

1. Minimum Order Quantity: 1 set/sets.
2. Packaging Details:
  - wood box.
  - overall dimensions: 3300\*3000\*1350 (L\*W\*H) .
  - you can choose the packaging detail.
3. Delivery time: Within 30days after receiving advance deposit.
4. Payment terms: L/D.D/A,T/T, Western Union, MoneyGram, Escrow.
5. Supply ability:3 set/sets per month or OEM.
6. Maintenance:
  - Provide precise instructions(manual).
  - Tech you how to fix it through videos.
  - Our technical staff can come to your company to show you how to repair, but your company is responsible for the costs.
  - We can train your staff the maintenance techniques at our company at our expense.
  - 1 year warranty
7. Production rate: 8000- 15000 cartons a day

Detailed information:

## CN401-2000 cutting machine

<b>Model</b>	<b>CN401-2000</b>
<b>Max.Paper feeding width (mm)</b>	<b>2000</b>
<b>Mechanical speed (m/min)</b>	<b>120</b>
<b>Diameter of circular blade</b>	<b>163mm</b>
<b>Shaft diameter</b>	<b>103mm</b>
<b>Power (Kw)</b>	<b>1.1</b>
<b>Weight (Kg)</b>	<b>1000</b>
<b>Dimensions (LxWxH) (mm)</b>	<b>2400x1100x1170</b>

### Function and structure:

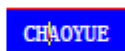
1. min wide size of cutting:60mm.
2. number of blades: 6set.
3. Pressure line wheels:8set.

### FEATURES:

- 1.it can produce single, double or more stories of corrugated carton.
- 2.It can divide paper, cut sides, press mark at one time.
- 3.It has a rational structure, easy and convenient operation.
- 4.Rotary Slitting and creasing machine is apply to produce monolayer, double layer, multilayer corrugated paper.
- 5.Slitting paper, cutting edge, and creasing need one time only.
- 6.Structure reasonable, easy operating.



### 3. Machine 3: CN311-2000 rotary slotting machine



**ORIGINAL**

**Dongguan liaobu chaoyue carton Machine business departme**

Address: Shangtun Industrial area, Liaobu Town Dongguan City, Guangdong Province, China

Tel: 86-15899924182 86-769-83289601 Fax: 86-769-82873557 Email: chaoyue03@cy0769.cn


Address: South Africa

Date: 14-Aug-2012

Contact: Ms. dheevashni padayachy

mail: dee2506@gmail.com

Port of Destination: Shenzhen, China

	1.max wide size of paper:1900mm 2.Min carton box length:240mm 3.Min carton box width:70mm 4.Slot width:7mm 5.Overall dimensions:3300*3000*1350mm	1	USD\$7,536.00	USD\$7,536.00
<b>Total:</b>		<b>2</b>	<b>USD \$10,161.00</b>	

Total cost: R60 815.52

**Payment & shipping Terms:**

8. Minimum Order Quantity: 1 set/sets.
9. Packaging Details:
  - wood box.
  - overall dimensions: 3300\*3000\*1350 (L\*W\*H) .
  - you can choose the packaging detail.
10. Delivery time: Within 30days after receiving advance deposit.
11. Payment terms: L/D.D/A,T/T, Western Union, Money Gram, Escrow.
12. Supply ability: 3 set/sets per month or OEM.
13. Maintenance:
  - Provide precise instructions (manual).
  - Tech you how to fix it through videos.
  - Our technical staff can come to your company to show you how to repair, but your company is responsible for the costs.
  - We can train your staff the maintenance techniques at our company at our expense.
  - 1 year warranty
14. Production rate: 8000- 15000 cartons a day




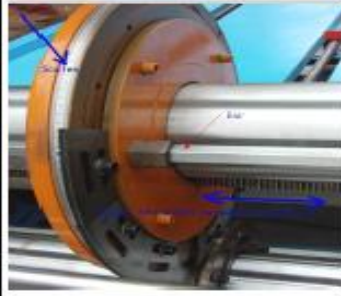

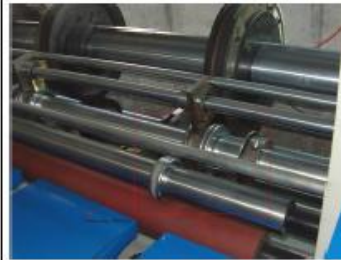

Detailed

Information:

## CN311-2000 rotary slotting machine

<b>Model</b>	<b>CN311-2000</b>
<b>max wide size of paper</b>	<b>1900mm</b>
<b>Min carton box length</b>	<b>240mm</b>
<b>Min carton box width</b>	<b>70mm</b>
<b>Min carton box width+height (W+H)</b>	<b>450mm</b>
<b>Max carton box width+height (W+H)</b>	<b>1450mm</b>
<b>Slot width</b>	<b>7mm</b>
<b>Power</b>	<b>2.6kw</b>
<b>Overall dimensions</b>	<b>3300x3000x1350mm</b>

### Structure:

Machine's Part	Note
	<p><b>Slotting part</b></p> <ol style="list-style-type: none"> <li>(1. Four knives. You can choose the numbers of the wheels when working.</li> <li>(2. Adjust the Baffles in different holes you can narrow the width of the sending platform.</li> <li>(3. Chain sender platform.</li> </ol>
	<p><b>Knives and scale</b></p> <ol style="list-style-type: none"> <li>(1. According to the Scale, you can adjust the slotting length.</li> <li>(2. According to adjust the Bar you can change the width between two slotting wheels.</li> </ol>
	<p><b>Operating Interface</b></p> <ol style="list-style-type: none"> <li>(1. Button Phase adjustment.</li> <li>(2. Easy operating screen.</li> <li>(3. Computer intelligence Monitor.</li> </ol>
	<p><b>Pressing Wheels</b></p> <ol style="list-style-type: none"> <li>(1. Pressing in Advance.</li> <li>(2. Adjust the elastic degree TO adjust the Pressing degree.</li> <li>(3. You can choose the numbers of pressing wheels according to your needs.</li> </ol>
	<p><b>Samples</b></p> <ol style="list-style-type: none"> <li>(1. Slotting accurate and Tidy.</li> <li>(2. Slotting width 7mm</li> <li>(3. No Raw edges.</li> <li>(4. Pressing well and easy to mold.</li> </ol>

#### 4. Machine 4: Cangzhoa Kingsun Imp.&Exp. Co.,Ltd

Cangzhou Kingsun Imp.&Exp.Co.,Ltd  
ADD:Lisiwei Industry Zone of Dongguang,Hebei,China  
TEL:+86 317 7759118  
FAX:+86 317 7759118  
MOBILE:+86 13785498142  
EMAIL:belle@czkingsun.com  
[Sales@czkingsun.com](mailto:Sales@czkingsun.com)  
WEB:Http://www.jingguangmachine.en.alibaba.com  
[Http://www.corrugated-machine.com](http://www.corrugated-machine.com)

##### **FYQ Series of Corrugated Paperboard Separating Paper,Rolling The Line,Slicing The Corner&Opening The Slot Machine**



**Price:FOB TIANJIN USD 6200**

**Use and Characteristics:** =R50 034

Move Mutually:

Slicing the cape opens the slot knife positive,tum over,the week faces the adjustment,having hand falter adjust,very convenient,and lock tight and dependable,open the slot accurate,should adjust function design tightly packed,through long enduring.

The electricity moves mutually:

Open slot knife 360 degree sare positive and tum over the adjustment,adopting the electrical engineering the tiny adjusting the device,operating very convenient,and adjust the size accurate,lock tight and dependable,open the slot accurate.

Technical Parameter:

The size of the diameter 480 mm

max passing paper 900x2000mm

min passing 260x450mm

the speed :80pcs /min

##### **BFY Thin Blade Slitter(manual adjust)**



**Price:FOB TIANJIN USD 41** =R 32 280

**Use and Characteristic:**

- 1.This machine is a kind of productive equipment with an integral whole process to separately slice the corrugated paperboard and roll the line.The working axle is used the good quality seamless steel pipe and has the advantages such as wear-resisting ,long using life and so on
- 2.Thin knife,thickness less than 1 mm smooth edge of the corrugated paper after cutting little crushing high quality paper board.
- 3.A pair of emery wheels for each knife
- 4.2 kinds of sharpening devices manual and pneumatic sharpening time and intervals decidecustomers.By manual operation sharpness and the heel is available.
- 5.Stability and long duration by gear or rack drive

**Total cost: R82 314**

**Support:**

1. Instructions in form of a manual and video's
2. 1 year warranty

## 5. Machine 5: The heavy duty box making machine



### Specification

- Uses up to 86 inch wide material depending on model
- 10.5 inch colour touch screen
- Runs 12 x 12 x 12 inch RSC in 13 seconds
- 5 head option for back scoring and cutting
- Quick blade change installation system
- Electrical requirements: 208/230 vac 1 phase 20 amps service
- Air requirements: 1 SCFM @ 80 psi
- 86 inch model operating area 12 x 14 feet
- 86 inch model weighs 1,900 pounds
- 86 inch model with automatic 20 second head set-up
- Over 30 box styles: stores 3,000 different boxes in memory -- custom styles available
- Runs 32 ECT single wall through 450 pound test double wall material
- Four emergency stops -- one at each corner
- Fused disconnect box safeguards operator
- Parts and labour warranty: 1 year or 500,000 boxes

### Standard features

- Ready to run immediately after installation
- Runs stock flat sheets of material, no cutting required
- Front cut and score head with 3 back cut and score heads
- Calculates and shows blank size -- all score allowances and top clearances applied automatically
- Includes air filter/regulator/shut-off 1/4 N.P.T.
- Includes in-feed and out-feed tables
- Safety interlocks on all doors with two emergency stops
- Blanks are slit with blades for cleaner operation and tight corners
- One blade cuts hundreds of boxes
- Lockable compartment stores manual and tools for operation and maintenance
- Support and technical assistance offered for lifetime of machine

## **Description**

The Heavy Duty Box Maker HBM-86 is designed for customers who need to make larger quantities of custom corrugated containers. Although the HBM is designed to run single wall material, it will run up to 450 pound double wall material and produce up to 300 boxes per hour depending on size and style. Versatile programming, accessible through a 10.5 inch colour touch screen, allows the heavy duty automated box making machine to re-create specific package designs whenever you need them: 33 different box styles, and 3000 different combinations of dimensions can be stored in memory. By storing box blank designs in memory, an HBM saves warehouse and production space: 12 x 12 feet of floor space for the 86-inch model. When round-the-clock operation is in the game plan, the Heavy Duty Box Maker can step up to the plate, with the right box, for the right job. Options available for the HBM, such as 5 heads, mean special orders and larger items can be produced.

## **Operation**

To set up the box styles and inner packaging, you just place your order at the HBM touch screen, then select an icon that represents a box blank style of your choice. The HBM leads you, step by step, through the entire process of choosing dimensions, quantity, and tabs for every style. Long containers for extrusions, or double wall boxes, are only a touch or two away. The touch screen automatically prompts when to start feeding sheets of material. Excess board, trimmed off during production, can be reused to make additional boxes, and environmentally friendly inner packaging such as bins, dividers, and pads. T-Roc Equipment offers support and technical assistance for the lifetime of the machine. In addition, HBM parts and labour warranty: provides coverage for one year, or 500,000 boxes.

## **Easy installation**

Sturdy roller casters make the HBM easy to move and install. Once in position, the machine is set firmly in place with its adjustable levelling feet. The 86-inch model, HBM-86, requires 12 x 12 feet.

## **Safety and maintenance**

The lexan hood's interlocking switches will shut down the Heavy Duty Box Maker if any of its doors open during operation. Manual emergency stop buttons, conveniently located at each corner, are additional safety features. Through years of experimentation, T-ROC Equipment has reduced required maintenance on its entire series of automated box making and assembly equipment. The Heavy-Duty Box Maker's quick change blade lasts for hundreds of boxes and the blade can be changed in just 10 seconds. The operator's manual and all the tools needed for maintenance are stored in a lockable compartment on the side of the machine.

## **Terms of Sale**

Terms are 50% with order, 50% before shipping, unless different terms are agreed to. Lease options are available. Machines are FOB Kansas City, Kansas. Delivery will be made by dedicated truck or T-ROC trailer. The delivery cost is quoted on the individual travel distance from Kansas City, KS to the customer's location. Crating for international shipping is \$1,500. Delivery lead time will be set based on backlog of orders T-ROC has on the day the 50% down payment is received. Customer is responsible for shipping and all applicable taxes.

## **Training:**

T-ROC training is \$1,000 plus travel expenses. Training will be quoted on an individual basis. Training covers two days of in-house instruction on operation and maintenance.

## Warranty:

Warranty for all T-ROC box machines is three years or 500,000 boxes on non-wear parts. Warranty covers all parts providing that:

- The machine has not been abused or used in a manner which it was not intended. This does not include parts that are subject to normal wear.
- The machine has not been repaired by a third party.
- The machine will be repaired at the customer location for one year from delivery. At T-ROC's discretion, the machine may need to be repaired at the factory. If this is necessary, T-ROC will pay for shipping both ways. After warranty period is complete, repairs can be made on-site if customer pays for all travel and accommodation expenses, plus labour rate.

## 6. Machine 6: The Super Duty Box making machine



## Specifications

- Uses up to 72 or 86 inch wide material depending on model
- Large 10.5 inch colour touch screen
- Runs 12 x 12 x 12 inch RSC in 11 seconds
- 5 head option for back scoring and cutting
- 5 head option can run boxes up to 32-foot long in one pass
- Scores on both sides for better folding of double wall or long boxes
- Over 30 box styles: stores 3,000 box configurations in memory -- custom styles available
- Quick blade change installation system
- Electrical requirements: 480 vac 3 phase @ 20 amps or 208/230 vac 3 phase @ 20 amps
- Air requirements: 1.5 SCFM @ 80 psi
- 72 inch model operating area 12 x 14 feet
- 72 inch model weighs 1,800 pounds
- 72 inch model has automatic 15 second head set-up
- 86 inch model operating area 14 x 14 feet
- 86 inch model weighs 2,000 pounds

- 86 inch model has automatic 18 second head set-up
- Runs 32 ECT single wall through 450 pound test double wall material
- Four emergency stops -- one at each corner
- Fused disconnect box safeguards operator
- Parts and labour warranty: 1 year or 500,000 boxes

### **Standard features**

- Ready to run immediately after installation
- Runs stock flat sheets of material, no cutting required
- Front cut and score head with 3 back cut and score heads
- Calculates and shows blank size --  
all score allowances and top clearances applied automatically
- Includes air filter/regulator/shut-off 1/4 N.P.T.
- Includes in-feed and out-feed tables
- All doors equipped with safety interlocks
- Blanks are slit with blades for cleaner operation and tight corners
- One blade cuts hundreds of boxes
- Lockable compartment stores manual and tools for operation and maintenance
- Support and technical assistance offered for lifetime of machine

### **Description**

The Super-Duty Box Maker, models SBM-72 and SBM-86, is designed to make large quantities of custom corrugated containers. With the 5-head option, boxes up to 32 feet long can be run in one pass. Its automatic set up is quicker, with an automatic set up time from 15 seconds, for the SBM-72 model, to 18 seconds, for the SBM-86 model. It can run 32 ECT single wall materials, up to 450-pound test double wall material. Its run time for a 12 x 12 x 12 inch RSC is 11 seconds. With a production speed up to 325 boxes per hour, the SBM's versatile programming, accessible through a colourful 10.5-inch color touch screen, allows the SBM to re-create specific package designs whenever you need them: over 30 box styles and 3000 combinations of dimensions can be stored in memory. This way, an SBM saves warehouse and production space: the SBM-72 takes 12 x 14 feet of floor space, while the SBM-86 uses 13 x 14 feet. When round-the-clock operation is in the game plan, the Super-Duty Box Maker can step up to the plate, with the right box, for the right job. Options available for the SBM, such as 5 heads, with bottom scoring, mean greater ability to fill special orders and make larger, boxes.

### **Operation**

To set up the box styles and inner packaging, you just place your order at the SBM touch screen, then select an icon that represents a box blank style of your choice. The SBM leads you, step by step, through the entire process of choosing dimensions, quantity, and tabs for every style. Long containers for extrusions, or doublewide boxes, are only a touch or two away. The touch screen automatically prompts when to start feeding sheets of material. Excess board, trimmed off during production, can be reused to make additional boxes, and environmentally friendly inner packaging such as bins, dividers, and pads. The SBM's quick change blade can be replaced in 10 seconds. T-Roc Equipment offers telephone support and technical assistance for the lifetime of the machine. In addition, the SBM parts and labour warranty provides coverage for one year, or 500,000 boxes.

## **Easy installation**

Sturdy roller casters make the SBM easy to move and install. Once in position, the 2000-pound machine can be set firmly in place with its adjustable levelling feet. The 72-inch model, SBM-72, requires 12 x 14 feet of floor space, while the 86-inch model, SBM-86, requires 13 x 14 feet.

## **Safety and maintenance**

The lexan hood's interlocking switches will shut down the Super-Duty Box Maker if any of its doors open during operation. Manual emergency stop buttons, conveniently located at each corner, and the fused disconnect box are additional safety features. Through years of experimentation, T-ROC Equipment has reduced required maintenance on its entire series of automated box making and assembly equipment. The Super-Duty Box Maker's quick change blade lasts for hundreds of boxes and the blade can be changed in just 10 seconds. The operator's manual and all the tools needed for maintenance are stored in a lockable compartment on the side of the machine.

## **Terms of Sale**

Terms are 50% with order, 50% before shipping, unless different terms are agreed to. Lease options are available. Machines are FOB Kansas City, Kansas. Delivery will be made by dedicated truck or T-ROC trailer. The delivery cost is quoted on the individual travel distance from Kansas City, KS to the customer's location. Crating for international shipping is \$1,500. Delivery lead time will be set based on backlog of orders T-ROC has on the day the 50% down payment is received. Customer is responsible for shipping and all applicable taxes.

## **Training:**

T-ROC training is \$1,000 plus travel expenses. Training will be quoted on an individual basis. Training covers two days of in-house instruction on operation and maintenance.

## **Warranty:**

Warranty for all T-ROC box machines is three years or 500,000 boxes on non-wear parts. Warranty covers all parts providing that:

- The machine has not been abused or used in a manner which it was not intended. This does not include parts that are subject to normal wear.
- The machine has not been repaired by a third party.
- The machine will be repaired at the customer location for one year from delivery. At T-ROC's discretion, the machine may need to be repaired at the factory. If this is necessary, T-ROC will pay for shipping both ways. After warranty period is complete, repairs can be made on-site if customer pays for all travel and accommodation expenses, plus labour rate.



## 7. Machine 7: HIPACK kinetic (new)

BOX MAKERS • GLUERS • DIGITAL PRINTERS • FINISHING SYSTEMS

**Autobox**  
SPECIALISTS IN BOX MAKING SYSTEMS

### Machinery Overview:

#### Machine: HIPAK Kinetic 2600AF

Single-pass auto-set boxmaking machine, with advanced energy reclaim system

#### Principal features and functions

- Fully auto tool less size change, typically 1 minute set time
- Kinetic energy reclaim system with lowest possible energy consumption and running costs
- High speed up to 1,000 boxes per hour
- Over 50 FEFCO box styles
- Convert from single to double wall corrugated board (max 10mm)
- Maximum sheet width: 2600mm
- Machine set-up: Is completely automatic - blades and creasing wheels position and pressure are set by servo motors dependant on box size and board thickness required, but can also be adjusted by the operator via the software.
- Software: simple intuitive menu driven programming.
- Remote access to software, programming etc from office network
- Touch Screen Control Panel for easy programming of new or stored box sizes and styles
- Feeder with magazine with capacity 300mm height of blanks
- Rubber faced, no crush feed roll
- Auto set slotting tools
- Auto set creasing tools
- Out-feed catcher / stacker table



#### Technical Specifications

Production Speed	Max speed of 1,000 boxes per hour
Box Styles	Over 50 Feeco styles possible with many already pre-programmed in the menu
Blank Size	MAX 2600mm (deckle) x unlimited (chop) MIN 100mm (deckle) x 330mm (chop)
Typical set-up time	approx 30 seconds - automatic / tool-less
Distance between slotting knives	MAX 1800mm (max height of 0201 style box) MIN 65mm
Slotting knife thickness	7mm (standard)
Slot length	MAX 508mm
Materials	1 - 10mm. E flute to 300/300/300 AA
Power requirements	415V 3-phase, 50/60Hz at 8 amps
Machine dimensions	3150mm x 2100mm x 1255mm
Net Weight	2300kg



2

BOX MAKERS • GLUERS • DIGITAL PRINTERS • FINISHING SYSTEMS

**Autobox**  
SPECIALISTS IN BOX MAKING SYSTEMS

### HIPAK Kinetic Box Styles

0200		0209		0411		0404
0201		0300		0933		0405
0202		0301		0934		0452
0203		0320		0230		0453
0205		0409		0231		0501
				0306		0502
				0310		0503
				0312		0504
				0313		0507
						0509
						0510
						0512
						0621
						0900 range

3



**AUTOBOX MACHINERY LTD CONDITIONS OF SALE - (FOR MACHINERY AND EQUIPMENT)**

**GENERAL** – The acceptance of our Quotation includes the acceptance of the following terms and conditions

**VALIDITY** – Unless previously withdrawn, our quotation is open for acceptance within the period stated therein or, where no period is stated, within thirty days only after its date of issue.

**LIMITS OF CONTRACT** – Our quotation includes only such goods, accessories and work as are specified therein.

**REPAIRS** – A quotation or estimate for repairs is made on the assumption that the repairs are reasonably capable of being carried out. If, on inspection, this is found not to be the case, we will advise you as soon as is reasonably practicable; no liability shall attach to us for any loss sustained by the repairs not being carried out and the cost of such inspection shall be borne by you. Goods or equipment sent to us for repair shall be delivered to our works free of all cost. Any firm quoted by us for delivery of goods required in our works or for completion of repairs on site shall not begin to run until we have received the plant to be repaired or, where repairs are to be carried out on site, have obtained access to the plant and all necessary information to enable us to put the work in hand. Any such firm is to be treated as an estimate only not involving us in any liability for failure to deliver or complete within such time unless you have suffered loss and the amount payable in respect thereof shall have been agreed in writing as liquidated damages, in which case our liability shall be limited to the amount so agreed to be paid. In all cases, whether a time for delivery or completion be quoted or not, the time therefore shall be extended by a reasonable period if delay in delivery or completion is caused by instructions, or lack of instructions, from you or by industrial disputes or by any cause whatsoever beyond our reasonable control.

**INSPECTION AND TESTS** – Our products are carefully inspected and, where practicable, submitted to our standard tests of our works before despatch.

**PERFORMANCE** – We will accept no liability for failure to obtain any performance figures quoted by us unless we have specifically guaranteed them, subject to any tolerances specified or agreed to by us, in an agreed form as liquidated damages. Before you become entitled to claim liquidated damages or to reject the goods we are to be given reasonable time and opportunity to rectify their performance. If you become entitled to reject goods, we will repay to you any sum paid by you to us in accordance of the contract price thereof. You assume responsibility that goods stipulated by you are sufficient and suitable for your purpose.

**LIABILITY FOR DELAY** – Any time quoted for despatch or delivery are to date from receipt by us of a written order to proceed and of all necessary information and drawings to enable us to put the work in hand. The time for despatch or delivery shall be extended by a reasonable period if delay in despatch or delivery is caused by instructions or lack of instructions from you or by industrial disputes or by any cause beyond our reasonable control.

**VARIATIONS** – In the event of variation or suspension of work by your instructions or lack of instructions the contract price may be adjusted accordingly.

**DELIVERY** – Unless otherwise specified in our Quotations, the price quoted includes delivery by any method of transport at our option. Unless otherwise specified, we shall not be responsible for offloading.

**LOSS OR DAMAGE IN TRANSIT** – When the price quoted includes delivery other than at our works, we will repair or at our option replace free of charge goods lost or damaged in transit; provided that we are given written notification of such loss or damage within such time as will enable us to comply with the carrier's conditions of carriage as affecting loss or damage in transit or, where delivery is made by our own transport, within a reasonable time after receipt of the Advice Note.

**TERMS OF PAYMENT** – Unless otherwise agreed, as detailed in our quotation 40% deposit with order, 60% prior to despatch of goods. In the event of the Customer cancelling the order for whatever reason, Autobox is entitled to retain any deposit payments received.

**TITLE** – Until the goods are paid for in full, title shall remain with Autobox. Upon delivery to the customer's premises, risk shall remain with the customer.

**STORAGE** – If we do not receive forwarding instructions sufficient to enable us to despatch the goods within 14 days after the date of notification that they are ready for despatch, you shall take delivery or arrange for storage. If you do not take delivery or arrange for storage, we shall be entitled to arrange storage either at our own works or elsewhere on your behalf and all charges for storage, for insurance or for demurrage shall be payable by you.

**INSTALLATION AND TRAINING** – Unless specifically excluded at the request of the customer, it is agreed that installation and training will be carried out by an Autobox approved engineer at the cost quoted. Autobox accepts no responsibility for faults or failure of any of the equipment in the event the customer declines the quotation for installation and training. Training shall be carried out at times suitable to the customer and Autobox or its installation agents.

**WARRANTY AND DEFECTS AFTER DELIVERY** – We will make good, by repair or the supply of a replacement, defects which, under proper use, appear in the goods within a period of twelve calendar months after the goods have been delivered and arise solely from faulty design other than a non-standard design or component specified by you for which we hereby disclaim responsibility in full, in materials or workmanship. Provided always that defective parts have been returned to us if we shall have so required.

**PATENTS** – We will indemnify you against any claim for infringement of Letters, Patents, Registered Designs, Trade Marks or Copyright (published at the date of the contract) by the use or sale of any article or material supplied by us to you and against all costs and damages which you may incur in any action for such infringement or for which you may become liable in any such action. Provided always that this indemnity shall not apply to any infringement which is due to our having followed a design or instruction furnished or given by you or to the use of such article or material in a manner or for a purpose or in a foreign country not specified by or disclosed to us, or to an infringement which is due to the use of such article or material in association or combination with any other article or material not supplied by us. Provided also that this indemnity is conditional on your giving to us at the earliest possible time notice in writing of any claim being made or action threatened or brought against you and on your permitting us at our own expense to conduct any litigation that may arise and all negotiations for a settlement of the claim. You on your part warrant that any design or instruction furnished or given by you shall not be such as will cause us to infringe any Letters Patent, Registered Design, Trade mark or Copyright in the execution of your work.

**LIMITATION ON CONTRACTORS' LIABILITY WHILE ON SITE** – If we, our agents or sub-contractors are on site for the purposes of the contract then, notwithstanding the provisions of Clause 15 we will indemnify you against direct damage or injury to your property or person or that of others.

**FINAL CERTIFICATE** – Upon expiry of the defects liability period specified in Clause 15 we shall be under no further obligation or liability to you either under the contract or in tort (including but not limited to negligence), unless within 91 days thereafter you shall have given us written notice of any matter in respect of which we remain obliged or liable to you.

**ARBITRATION** – If at any time any question, dispute or difference whatsoever shall arise between you and ourselves, upon, in relation to, or in connection with the contract, either of us may give to the other notice in writing of the existence of such question, dispute or difference and the same shall be referred to the arbitration of a person to be mutually agreed upon, or failing agreement within 30 days of receipt of such notice, of some person appointed by the President for the time being of the Chartered Institute of Arbitrators.

**STATUTORY AND OTHER REGULATIONS** – If the cost to us of performing our obligations under the contract shall be increased or reduced by reason of the making or amendment after the date of tender of any law or of any order, regulation, or bye-law having the force of law that shall affect the performance of our obligations under the contract, the amount of such increase or reduction shall be added to or deducted from the contract price as the case may be.

**LEGAL CONSTRUCTION** – The contract shall in all respects be construed and operate as an English contract and in conformity with English law.

## Summary:

**Price Summary:**

HIPAK Kinetic 2600 AF	€88,601	= R913 466
HICUT 2600	€62,601	
HIFEED	€39,750	
HIFLEX 300 x 500	€32,200	
HIFLEX 1000 x 1300 mm	€46,200	
HIPrint 1000 x 70	€21,750	
Exit Stacking System	€4,800	

**Payment terms:** 40% Deposit with order  
60% Prior to delivery

**Delivery:** Prices exclude delivery and installation  
**Lead time:** 12-14 weeks from receipt of deposit  
**Quote Validity:** 30 days  
**Warranty:** 24 months parts only

All goods shall remain the property of Autobox Machinery Ltd until paid for in full

## 8. Machine 8: HiPack(used)



MACHINE:	HIPAK	MODEL:	2675AF (All Electric)
Model Specifics:			
Power Requirements:	415V 3 Phase and neutral, 50-60Hz, 8 amps		
Box Styles:	Over 50 FEFCO Styles, 12 pre-programmed		
Max. Blank Size:	2400mm/94.5" (deckle) x any length (chop)		
Min. Blank Size:	100mm/4" (deckle) x 330mm/13" (chop)		
Typical Set-up Time:	30 seconds		
Standard Max. Slot Length:	508mm/20"		
Distance Between Slots:	1400mm/55" x 65mm/2.5" (i.e height of an 0201 case)		
Minimum First Panel:	80mm/3" (no min or max for following slots)		
Slot Width:	8mm / 5/16"		
Glue Flap:	Variable Length		
Materials:	All single-wall corrugated up to 300/300 /300 AA double-wall,		
Overall Dimensions:	3000mm/118" wide x 2100mm/82.5" long (excl. catcher table) x 1255mm/49.5" height (approx.)		
Crating:	EXPORT – 2216 kg / 4885 lbs UK – 1800 kg / 3968 lbs		
Electronics:	MK7 Touch-screen, graphic interface, PC/PLC control		
Expected Availability:	3-4 Weeks from receipt of order		

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Age: 2008

Condition: 8\*(graded 1-10, 10 being immaculate)

All machines brought into the factory for second user purposes are thoroughly serviced and parts repaired/replaced where necessary, so as to enable Autobox Machinery Ltd. To commission the machine as industry ready and to offer a warranty

Warranty: 6 Months parts

€52,000 =R536 120



For all enquiries regarding this machine please

Telephone on +44 (0)1525 379 359

Disclaimer: Whilst Autobox Machinery Ltd. has made every effort to ensure all information above is factually correct and accurate, particular specifications may vary in detail from the above outline. Please contact the sales team on 01525 379359 to confirm product information. Autobox Machinery Ltd. reserves the right to withdraw any machine/equipment from market after specific advert release to potential customers due to a continuously changing supply and demand.

## Appendix G: Monte Carlo simulation for the in-house manufacturing of cardboard boxes to use only

Iteration no	Cardboard boxes	Electricity	Labour	Tape	Fixed costs	Total monthly costs
1	431304.08	189.45	17066.48374	11407.59619	4908.08	464875.6899
2	436685.47	210.1	15024.3993	17225.33209	4908.08	474053.3814
3	1000390.76	212.62	12455.80949	109627.19	4908.08	1127594.459
4	553676.55	122.61	16742.01091	83335.55005	4908.08	658784.801
5	1239915.86	172.43	16391.35798	71617.64808	4908.08	1333005.376
6	1349300.51	161.25	14490.53427	69327.37199	4908.08	1438187.746
7	1035407.35	124.56	14197.56132	128633.4317	4908.08	1183270.983
8	1297481.98	166.9	16123.03842	105398.1608	4908.08	1424078.159
9	582717.06	136.18	13375.56294	103704.8441	4908.08	704841.727
10	660367.01	181.97	13758.63003	86187.98871	4908.08	765403.6787
11	1297950.05	228.43	12677.95795	30161.97985	4908.08	1345926.498
12	993810.8	159.43	18831.9996	65811.83733	4908.08	1083522.147
13	962230.19	235.41	12732.4438	55937.4279	4908.08	1036043.552
14	882548.99	122.5	13347.1015	19959.45482	4908.08	920886.1263
15	1049721.23	167.82	17657.94979	44450.88599	4908.08	1116905.966
16	722096.81	227.36	16540.18862	122030.7641	4908.08	865803.2028
17	915437.22	148.42	12738.47047	75341.84365	4908.08	1008574.034
18	1186758.84	122.06	16713.84798	35424.64978	4908.08	1243927.478
19	1000167.55	145.02	15874.58014	103941.7248	4908.08	1125036.955
20	1019206.08	172.48	16967.05907	46937.04645	4908.08	1088190.746
21	518890.29	212.03	15347.96567	45577.44428	4908.08	584935.81
22	1039628.28	206.99	13140.86347	74670.76293	4908.08	1132554.976
23	1192074.3	188.16	14079.80702	93209.43616	4908.08	1304459.783
24	1350937.54	138.78	12451.93516	98221.60026	4908.08	1466657.935
25	734421.52	154.77	12952.43979	69109.67294	4908.08	821546.4827
26	1340595.18	180.37	16096.56996	87407.03699	4908.08	1449187.237
27	1044051.68	191.18	14092.25311	30863.73158	4908.08	1094106.925
28	488673.49	187.71	17369.34652	108817.1299	4908.08	619955.7565
29	1378624.63	181.37	14514.65338	85337.92356	4908.08	1483566.657
30	665841.86	173.73	16468.63781	62786.12934	4908.08	750178.4372
31	460236.66	197.05	15226.43397	18289.49565	4908.08	498857.7196
32	1298259.04	194.81	13660.4146	127497.4445	4908.08	1444519.789
33	1016404.41	131.51	17951.69863	118095.959	4908.08	1157491.658
34	407564.41	225.57	12920.94975	87565.47974	4908.08	513184.4895
35	969805.88	194.34	13157.5647	105956.6505	4908.08	1094022.515
36	739557.78	201.49	16662.00653	125121.4421	4908.08	886450.7986
37	1363290.57	178.04	12884.24459	46000.40874	4908.08	1427261.343
38	418418.81	162.82	11704.44677	25113.6492	4908.08	460307.806
39	633503.05	240.9	18452.94459	84087.00116	4908.08	741191.9757
40	1233700.73	145.64	17027.3594	53845.66128	4908.08	1309627.471
41	481492.66	210.74	18239.373	17331.55123	4908.08	522182.4042

42	668808.63	242.33	17983.00873	114520.1067	4908.08	806462.1554
43	561501.28	149.16	15225.7925	107683.1728	4908.08	689467.4853
44	1412918.68	134.69	12384.54825	105158.1082	4908.08	1535504.106
45	672243.7	125.5	18493.01992	74699.47661	4908.08	770469.7765
46	1342217.57	195.34	15780.9868	113869.1554	4908.08	1476971.132
47	1342104.02	229.9	14523.37541	105093.9551	4908.08	1466859.331
48	1061881.67	233.72	12100.32793	23149.25711	4908.08	1102273.055
49	496821.82	131.69	13329.9959	87107.26527	4908.08	602298.8512
50	1264305.16	228.99	17717.4886	12786.9158	4908.08	1299946.634
51	810058.18	133.02	13730.92931	83473.96839	4908.08	912304.1777
52	866028.92	241.63	12726.06991	79564.2104	4908.08	963468.9103
53	441041.67	211.24	13162.33731	29203.96893	4908.08	488527.2962
54	1275545.43	230.79	13927.71778	123684.7396	4908.08	1418296.757
55	1228196.41	187.62	18252.39705	78374.07997	4908.08	1329918.587
56	972993.99	198.27	11688.23155	60123.40455	4908.08	1049911.976
57	853221.85	206.58	18825.39675	114002.2463	4908.08	991164.153
58	1253227.32	236.46	14548.41326	117590.8975	4908.08	1390511.171
59	1304890.18	190.6	13334.87098	96663.90237	4908.08	1419987.633
60	1163303.63	236.28	17118.01966	25108.15687	4908.08	1210674.167
61	466491.17	189.12	17172.85631	38896.53339	4908.08	527657.7597
62	1379751.23	187.29	18758.71905	105761.5065	4908.08	1509366.826
63	1211368.98	217.21	16376.45013	27595.39524	4908.08	1260466.115
64	1195431.36	212.56	17668.30089	63850.59452	4908.08	1282070.895
65	1100439.18	190.85	15408.1694	117152.5902	4908.08	1238098.87
66	1123633.93	127.14	12457.07866	61981.23205	4908.08	1203107.461
67	381604.49	150.98	13109.13554	60315.02318	4908.08	460087.7087
68	1217521.86	166.53	16092.67038	34938.78609	4908.08	1273627.926
69	1322721.13	165.75	15794.86622	90302.69662	4908.08	1433892.523
70	601346.82	124.16	18247.39309	49810.45597	4908.08	674436.9091
71	687265.99	229.57	17060.99376	34811.92818	4908.08	744276.5619
72	1383124.57	228.27	15261.74213	79040.80319	4908.08	1482563.465
73	915802.86	232.6	14905.27155	67283.14235	4908.08	1003131.954
74	1151532.4	131.93	16745.10144	61805.17805	4908.08	1235122.689
75	888278.42	140.5	12346.10975	75626.24912	4908.08	981299.3589
76	1194353.21	160.18	17424.34565	98622.13519	4908.08	1315467.951
77	461686.39	159.46	15383.90844	102433.2417	4908.08	584571.0801
78	1132941.14	195.29	13235.34859	112925.6993	4908.08	1264205.558
79	959497.04	233.31	17089.70348	79451.80565	4908.08	1061179.939
80	841653.44	138.92	17228.47027	98685.12296	4908.08	962614.0332
81	1398957.65	160.32	12624.09199	109155.278	4908.08	1525805.42
82	497045.82	224.45	12042.4654	50700.32226	4908.08	564921.1377
83	566663.93	201.76	18285.83978	127127.5469	4908.08	717187.1567
84	505993.44	233.91	17716.19356	89275.02269	4908.08	618126.6462
85	690672.24	220.5	16636.07161	86389.13939	4908.08	798826.031
86	1298704.53	164.98	13454.91065	92305.83746	4908.08	1409538.338
87	1359368.83	217.92	15435.94145	53265.11468	4908.08	1433195.886



88	1039461.19	155.16	12594.23795	116121.3692	4908.08	1173240.037
89	1047372.71	208.45	14648.42069	46443.98544	4908.08	1113581.646
90	943097.27	169.04	17320.11691	129055.1238	4908.08	1094549.631
91	720822.26	144.59	16770.41793	43071.29835	4908.08	785716.6463
92	1307499.82	123.29	15903.0614	12056.18106	4908.08	1340490.432
93	478951.13	239.15	12667.41285	77102.57732	4908.08	573868.3502
94	927477.41	198.18	11939.5579	6480.586633	4908.08	951003.8145
95	895430.14	192.01	13072.15971	28439.8907	4908.08	942042.2804
96	1073852.84	158.9	11541.60992	79116.51099	4908.08	1169577.941
97	986798.12	174.56	13886.58153	37390.59298	4908.08	1043157.935
98	1170439.53	123.13	11724.50006	14325.77609	4908.08	1201521.016
99	457322.13	140.01	11919.76023	72311.83726	4908.08	546601.8175
100	900250.39	154.86	15531.10013	55806.39493	4908.08	976650.8251
101	1445124.8	197.8	12866.04174	100187.874	4908.08	1563284.596
102	411595.27	185.75	17542.08158	3504.171445	4908.08	437735.353
103	965660.45	239.75	18868.14358	122520.0297	4908.08	1112196.453
104	1063104.49	162.4	13886.82004	72738.34746	4908.08	1154800.137
105	540621.21	152.43	16169.37226	23660.06448	4908.08	585511.1567
106	1264919.46	162.27	14648.60171	43494.82438	4908.08	1328133.236
107	1191123.07	152.25	12371.0214	120713.172	4908.08	1329267.593
108	760505.9	179.19	16913.30145	5849.51954	4908.08	788355.991
109	458027.25	235.87	14286.64381	6790.665548	4908.08	484248.5094
110	643401.87	152.5	17273.26396	126445.0943	4908.08	792180.8083
111	1333790.29	143.18	14544.12357	40489.5691	4908.08	1393875.243
112	607344.32	227.95	11970.49021	45365.6165	4908.08	669816.4567
113	1430000.51	156.55	16675.52815	116683.22	4908.08	1568423.888
114	1118475.95	154.64	15797.1369	4140.353744	4908.08	1143476.161
115	518965.63	176.67	17154.67591	23360.31434	4908.08	564565.3703
116	1047159.14	141.71	13858.43863	27212.09185	4908.08	1093279.46
117	930011.48	161.08	17870.70195	56692.06561	4908.08	1009643.408
118	408880.91	195.55	18631.98965	121140.6465	4908.08	553757.1762
119	1037368.95	180.15	13374.8014	79484.61693	4908.08	1135316.598
120	1122334.55	190.25	14321.7703	11785.60065	4908.08	1153540.251
121	694007.96	209.42	11797.37075	92781.60069	4908.08	803704.4314
122	1354333.11	211.43	18259.79428	30885.59693	4908.08	1408598.011
123	1138832.05	162.87	11458.81731	114285.9105	4908.08	1269647.728
124	993374.27	218.88	12408.56136	7673.869946	4908.08	1018583.661
125	822567.88	141.9	18090.66381	60939.09259	4908.08	906647.6164
126	1333518.74	227.91	11969.95895	72125.63513	4908.08	1422750.324
127	437963.76	169.89	16490.86677	25267.70566	4908.08	484800.3024
128	1092428.45	237.51	17210.83797	87986.66678	4908.08	1202771.545
129	1312782.72	218.63	14457.62976	17315.63877	4908.08	1349682.699
130	829153.98	168.52	12824.95975	75058.11531	4908.08	922113.6551
131	906220.09	242.31	14060.12775	99418.07808	4908.08	1024848.686
132	757528.59	136.22	18393.45456	100380.581	4908.08	881346.9255
133	1445116.28	242.62	18578.48914	69999.17459	4908.08	1538844.644

134	791267.05	203.53	12936.57136	28707.38717	4908.08	838022.6185
135	778783.24	225.76	14057.11909	15605.57726	4908.08	813579.7763
136	1137880.55	213.13	17459.42344	91831.90501	4908.08	1252293.088
137	615693.25	153.95	14479.2436	37809.7014	4908.08	673044.225
138	1271364.13	238.31	12011.70954	74078.19796	4908.08	1362600.427
139	820556.72	221.18	15858.94784	7484.200086	4908.08	849029.1279
140	1094998.46	216.38	15121.85517	77006.96117	4908.08	1192251.736
141	1237048.45	144.22	15767.34253	92921.81864	4908.08	1350789.911
142	1170328.87	158.04	17514.85094	61561.4164	4908.08	1254471.257
143	1205113.32	219.35	15983.21095	11650.43007	4908.08	1237874.391
144	563730.04	227.87	14359.69494	40761.36023	4908.08	623987.0452
145	1398914.08	184.23	12639.96426	130690.453	4908.08	1547336.807
146	1061545.45	224.58	18400.05073	91951.79051	4908.08	1177029.951
147	1242126.87	170.47	18631.55424	4851.711663	4908.08	1270688.686
148	856184.08	200.71	17775.88674	97206.72042	4908.08	976275.4772
149	769613.72	164.47	16423.66419	25786.87576	4908.08	816896.81
150	1186233.78	175.2	16172.18728	118035.1555	4908.08	1325524.403
151	540192.66	187.7	13584.63103	75300.91131	4908.08	634173.9823
152	1339766.65	139.43	16686.86749	28877.23463	4908.08	1390378.262
153	1229507.32	235.58	13530.35642	69013.73751	4908.08	1317195.074
154	1330989.52	221.61	17956.13055	79654.74492	4908.08	1433730.085
155	572653.94	231.57	12370.99109	110531.6451	4908.08	700696.2262
156	1063106.64	242.96	15786.45263	85836.70031	4908.08	1169880.833
157	395978.76	227.69	16154.39948	36900.00567	4908.08	454168.9352
158	1336424.25	179.03	12956.63836	26903.48427	4908.08	1381371.483
159	802377.68	239.5	12179.83804	4790.309637	4908.08	824495.4077
160	734408.29	216.47	17892.96499	32117.27338	4908.08	789543.0784
161	416369.91	166.49	17216.90008	121091.2483	4908.08	559752.6283
162	791005.12	129.13	12716.67628	45875.38728	4908.08	854634.3936
163	1194091.84	235.86	15257.80121	99765.38023	4908.08	1314258.961
164	814215.2	213.73	15150.26874	98555.37294	4908.08	933042.6517
165	927863.11	159.6	14276.92658	13790.37993	4908.08	960998.0965
166	674935.33	211.92	11497.26042	66669.52296	4908.08	758222.1134
167	957906.07	122.01	12438.00415	13129.17789	4908.08	988503.342
168	709910.52	225.52	12944.70924	103636.8561	4908.08	831625.6854
169	1072468.04	196.96	15713.25346	88571.30058	4908.08	1181857.634
170	988365.21	166.65	14706.22623	85016.52642	4908.08	1093162.693
171	1252449.88	173.09	12765.99541	121891.0205	4908.08	1392188.066
172	632669.28	199.56	15251.36595	34322.88917	4908.08	687351.1751
173	871396.97	232.43	14395.74637	15590.33822	4908.08	906523.5646
174	957147.4	216.44	14840.90805	107802.7486	4908.08	1084915.577
175	533961.45	160.01	15329.94978	30648.79152	4908.08	585008.2813
176	647915.1	205.24	13772.91947	23995.59406	4908.08	690796.9335
177	1028195.37	125.14	17893.54929	74131.2666	4908.08	1125253.406
178	512442.88	181.49	11944.7827	99489.20356	4908.08	628966.4363
179	1107202.31	178	15999.81248	106793.8324	4908.08	1235082.035

180	717538.62	221.01	17676.91665	100145.6519	4908.08	840490.2786
181	986706.98	148.11	12497.93385	73889.93225	4908.08	1078151.036
182	1338728.32	219.6	14535.9254	4349.049975	4908.08	1362740.975
183	1155137.45	183.67	18330.45448	23165.05117	4908.08	1201724.706
184	937593.32	211.97	15873.9115	119630.2892	4908.08	1078217.571
185	517748.78	161.86	11980.55394	56137.8964	4908.08	590937.1703
186	542335.8	239.33	16998.67279	57481.28087	4908.08	621963.1637
187	555610.02	158.59	13057.79062	57165.1365	4908.08	630899.6171
188	727536.12	159.87	12108.8561	77548.23884	4908.08	822261.1649
189	1260011.96	140.91	17075.1762	17854.78256	4908.08	1299990.909
190	1099838.58	123.5	15896.37496	23698.8292	4908.08	1144465.364
191	590332.44	242.5	15399.11288	113313.9427	4908.08	724196.0756
192	1152345.67	123.34	12614.0699	25255.12624	4908.08	1195246.286
193	947713.17	177.91	15011.29568	82880.30612	4908.08	1050690.762
194	1436765.72	229	18708.49111	18268.90738	4908.08	1478880.198
195	449142.08	177.19	13837.94845	49417.17245	4908.08	517482.4709
196	954620.69	168.09	16656.44838	54042.09109	4908.08	1030395.399
197	1028556.17	161.23	18191.98754	123368.6341	4908.08	1175186.102
198	501959.61	201.75	11929.29167	120336.5101	4908.08	639335.2417
199	1077612.83	150.39	18050.68512	19831.54432	4908.08	1120553.529
200	1025646.36	142.95	14840.4422	65220.15444	4908.08	1110757.987
201	852399.37	149.09	11531.38511	17510.53682	4908.08	886498.4619
202	699040.05	137	16252.11823	89996.27571	4908.08	810333.5239
203	812953.98	238.35	14197.91382	98683.79311	4908.08	930982.1169
204	458777.92	222.04	13574.92362	89744.63824	4908.08	567227.6019
205	723503.22	148.42	11568.71675	14857.44092	4908.08	754985.8777
206	1104562.85	121.65	13072.75831	34128.38411	4908.08	1156793.722
207	1187770.46	157.88	16943.16031	105814.7675	4908.08	1315594.348
208	594190.81	229.56	18023.01787	124252.3268	4908.08	741603.7947
209	1019427.06	181.54	12540.00644	105165.1003	4908.08	1142221.787
210	1075201.45	151.75	11728.02029	112011.5937	4908.08	1204000.894
211	838043.56	170.31	13886.07767	36348.05321	4908.08	893356.0809
212	1452476.7	206.44	12200.13721	20258.8632	4908.08	1490050.22
213	1060865.37	222.23	13772.28962	76051.93997	4908.08	1155819.91
214	1326820.97	229.15	17110.4852	22606.55715	4908.08	1371675.242
215	514460.69	219.05	16370.82309	50939.60406	4908.08	586898.2471
216	490695.51	129.02	12739.24473	87081.31713	4908.08	595553.1719
217	1089072.52	143.76	14248.93864	73306.45484	4908.08	1181679.753
218	1093715.29	241.07	12731.70089	85368.18633	4908.08	1196964.327
219	1367836	155.62	11911.57027	41213.31635	4908.08	1426024.587
220	635352.46	192.11	17790.52797	78143.65674	4908.08	736386.8347
221	883663.81	173.04	12010.72191	124301.8817	4908.08	1025057.534
222	1297089.06	185.02	11897.49254	44065.53841	4908.08	1358145.191
223	1155051.81	202.52	11849.51088	61252.54592	4908.08	1233264.467
224	1302784.29	195.47	14866.82386	55241.50446	4908.08	1377996.168
225	678939.34	173.36	12270.70519	62108.25177	4908.08	758399.737



226	1227415.2	143.29	13640.15265	109750.2626	4908.08	1355856.985
227	604135.75	195.6	18770.90465	114930.7281	4908.08	742941.0627
228	442901.58	238.59	17892.65925	108128.8331	4908.08	574069.7424
229	670016.94	160.24	17197.73307	123192.5162	4908.08	815475.5093
230	1011839.76	151.83	12471.35577	72014.5955	4908.08	1101385.621
231	909679.97	188.65	16363.2654	113841.1407	4908.08	1044981.106
232	768479.39	129.75	11739.17735	35128.08876	4908.08	820384.4861
233	379580.63	178.18	14235.79259	4859.751887	4908.08	403762.4345
234	937684.39	199.74	17025.9503	67494.7959	4908.08	1027312.956
235	1345211.13	216.31	13033.32583	10230.0624	4908.08	1373598.908
236	500315.46	152.68	13604.93188	89393.43056	4908.08	608374.5824
237	1132560.26	155.94	14028.01283	118760.2174	4908.08	1270412.51
238	1180020.88	138.89	14719.48616	99242.68521	4908.08	1299030.021
239	568367.45	218.19	15014.32771	100432.6578	4908.08	688940.7056
240	1114249.22	239.93	12686.66643	57033.39777	4908.08	1189117.294
241	385494.4	205.75	17705.06446	64389.02342	4908.08	472702.3179
242	794522.11	163.66	13704.71997	99446.70047	4908.08	912745.2704
243	564177.19	187.53	14949.53284	94624.06469	4908.08	678846.3975
244	1098463.23	206.21	13405.772	95315.16118	4908.08	1212298.453
245	1116989.19	242.53	17928.37182	20413.56732	4908.08	1160481.739
246	604832.38	205.56	12816.11632	112405.9579	4908.08	735168.0942
247	1094221.68	206.05	13422.69614	2510.390341	4908.08	1115268.896
248	587414.83	197.3	17685.56594	60146.35178	4908.08	670352.1277
249	1269632.44	208.4	16939.30181	77470.23934	4908.08	1369158.461
250	941712.69	183.24	17977.77181	46593.76607	4908.08	1011375.548
251	1060961.87	175.46	12080.68332	84860.04132	4908.08	1162986.135
252	1262090.96	208.71	15507.05364	120871.0859	4908.08	1403585.889
253	1054234.86	172.12	11758.55737	35430.09212	4908.08	1106503.709
254	1205047.74	226.15	14598.59764	33006.84732	4908.08	1257787.415
255	437226.01	225.51	16747.71342	102494.4436	4908.08	561601.7571
256	820434.87	215.36	18414.06252	55219.15004	4908.08	899191.5226
257	1075973.59	204.17	16326.61472	22757.62627	4908.08	1120170.081
258	534143.84	141.84	14437.23725	17380.78161	4908.08	571011.7789
259	1076006.1	190.77	12019.6229	65201.18554	4908.08	1158325.758
260	1423609.53	208.39	16147.50764	20482.54082	4908.08	1465356.048
261	517938.2	198.91	13380.32937	122996.0348	4908.08	659421.5542
262	1373935.51	128.79	16707.51138	125152.9227	4908.08	1520832.814
263	430206.97	190.96	13391.0676	9289.464387	4908.08	457986.542
264	858827.38	146.62	16137.75986	131551.7604	4908.08	1011571.6
265	626717.26	237.76	18646.0508	77894.68672	4908.08	728403.8375
266	831561.94	138.15	16106.64374	28789.26636	4908.08	881504.0801
267	1285030.75	183.34	17631.72716	3025.662507	4908.08	1310779.56
268	687086.97	225.98	14115.78184	100162.116	4908.08	806498.9278
269	1401356.43	207.72	16451.02611	77377.8237	4908.08	1500301.08
270	1234160.39	176.29	13844.67907	53847.42114	4908.08	1306936.86
271	834341.72	218.24	14950.48173	26138.21135	4908.08	880556.7331

272	1450738.7	174.09	14614.34577	101235.3035	4908.08	1571670.519
273	1324199.04	151.27	15248.82211	25382.67432	4908.08	1369889.886
274	965895.46	209.49	13076.34788	54581.66498	4908.08	1038671.043
275	488960.5	157.96	13551.53571	60613.96793	4908.08	568192.0436
276	1294924.37	176.87	13025.98688	49029.55195	4908.08	1362064.859
277	442040.66	237.85	18823.54644	10422.22955	4908.08	476432.366
278	529052.11	180.29	13240.91322	42126.69095	4908.08	589508.0842
279	494669.93	236.57	15442.82529	42439.74183	4908.08	557697.1471
280	818970.58	175.17	15544.43232	2853.53463	4908.08	842451.7969
281	534313.3	139.79	11792.81308	50286.26079	4908.08	601440.2439
282	570084.77	178.65	13679.46087	16013.78168	4908.08	604864.7426
283	718567.57	226.81	13573.41455	55658.21301	4908.08	792934.0876
284	1022332.64	224.31	16718.74264	36828.37909	4908.08	1081012.152
285	466122.31	124.14	18421.65648	24883.95555	4908.08	514460.142
286	1186123.39	217.3	16462.00692	104086.1049	4908.08	1311796.882
287	442541.14	197.12	18364.37567	69980.25911	4908.08	535990.9748
288	1258530.95	165.98	14996.89119	83869.93163	4908.08	1362471.833
289	940921.98	228.21	17142.53064	15889.24944	4908.08	979090.0501
290	801933.18	171.64	16050.84786	42234.7069	4908.08	865298.4548
291	734061.61	200.69	15068.84384	48962.93649	4908.08	803202.1603
292	839650.57	216.66	16625.35704	130257.9529	4908.08	991658.6199
293	471356.07	229.89	15356.94177	78107.48762	4908.08	569958.4694
294	453428.68	134.65	12852.51821	77829.30344	4908.08	549153.2317
295	914379.92	212.13	16271.33568	98674.60656	4908.08	1034446.072
296	1434807.22	181.96	18715.99437	33447.29648	4908.08	1492060.551
297	696387.73	161.51	12572.35273	27064.48088	4908.08	741094.1536
298	414358.18	177.25	12259.92523	87803.28778	4908.08	519506.723
299	1337198.36	123.47	15354.20146	108661.2595	4908.08	1466245.371
300	1356233.49	157.15	16948.48186	83476.10311	4908.08	1461723.305
301	606544.06	226.72	13484.18192	20635.50682	4908.08	645798.5487
302	709458.57	169.94	11734.44587	80759.4437	4908.08	807030.4796
303	981021.47	232.06	11652.58649	41319.6497	4908.08	1039133.846
304	1285753.8	184.73	14200.44747	122763.113	4908.08	1427810.17
305	1209829.48	131.62	16471.39189	23600.556	4908.08	1254941.128
306	948705.07	203.89	17530.00499	90286.175	4908.08	1061633.22
307	1327497.36	187.13	16647.16071	38405.42152	4908.08	1387645.152
308	1355555.75	225.44	15324.97012	40308.38339	4908.08	1416322.624
309	962477.41	163.87	12669.03175	94628.10585	4908.08	1074846.498
310	616791.95	206.37	18172.50115	43271.1698	4908.08	683350.0709
311	695593.34	218.81	14563.89757	65253.67178	4908.08	780537.7993
312	1451616.93	198.06	13996.78012	41887.6667	4908.08	1512607.517
313	1038977.6	232.81	14534.59888	39076.31038	4908.08	1097729.399
314	908501.03	179.62	13702.21696	76805.22913	4908.08	1004096.176
315	1217747.93	146.8	12827.14837	96784.45404	4908.08	1332414.412
316	1342371.11	162.99	17883.11838	48099.55236	4908.08	1413424.851
317	1186260.53	153.35	13833.63453	75627.7025	4908.08	1280783.297

318	764402.03	190.79	18243.64762	108249.1956	4908.08	895993.7432
319	1030980.6	144.76	12691.80411	49611.6927	4908.08	1098336.937
320	1055263.72	130.9	12136.84988	28215.42242	4908.08	1100654.972
321	417210.46	149.59	13887.09827	128107.7609	4908.08	564262.9891
322	667009.59	231.24	18763.68766	44944.99213	4908.08	735857.5898
323	1346648.56	197.91	16116.96792	47030.49266	4908.08	1414902.011
324	1444486.44	220.21	11996.50617	48960.976	4908.08	1510572.212
325	390657.73	238.67	18708.91737	26529.81251	4908.08	441043.2099
326	645421.37	190.04	15293.92129	20383.53233	4908.08	686196.9436
327	856144.08	241.16	17241.10988	61482.41358	4908.08	940016.8435
328	1048088.22	170.76	14167.63283	77402.10789	4908.08	1144736.801
329	1072169.17	206.88	17803.09323	47125.1975	4908.08	1142212.421
330	642658.27	194.32	13993.58814	120313.4952	4908.08	782067.7534
331	1004903.93	123.09	13257.72727	44237.32375	4908.08	1067430.151
332	1069413.52	125.1	18267.23648	2850.192152	4908.08	1095564.129
333	1074467.77	147.14	18450.06876	9539.283666	4908.08	1107512.342
334	1282051.89	241.46	18467.28118	2647.165388	4908.08	1308315.877
335	779130.94	220.95	14166.43724	59400.24279	4908.08	857826.65
336	1378809.14	175.86	15030.19982	70830.84966	4908.08	1469754.129
337	1270489.57	162.11	14446.09803	91571.98544	4908.08	1381577.843
338	494987.3	242.38	14689.49176	6255.070294	4908.08	521082.3221
339	598071.76	151.3	13527.04158	11510.60668	4908.08	628168.7883
340	695160.41	206.31	16591.81389	105087.2719	4908.08	821953.8858
341	1168617.86	178.32	16667.14416	38551.21029	4908.08	1228922.614
342	1255590.29	191.04	16777.84434	8885.217369	4908.08	1286352.472
343	1100975.47	214.61	16297.64465	60018.81465	4908.08	1182414.619
344	693005.36	174.53	17507.5046	82635.07769	4908.08	798230.5523
345	958019.15	199.88	17783.46653	122979.6388	4908.08	1103890.215
346	844755.66	152.24	18446.75673	70780.59027	4908.08	939043.327
347	1078570.97	149.89	14258.72111	44267.01932	4908.08	1142154.68
348	411804.55	223.73	17986.11448	21257.12641	4908.08	456179.6009
349	796262.26	240.68	12469.94951	50028.36241	4908.08	863909.3319
350	1118914.59	130.05	13963.877	34929.06814	4908.08	1172845.665
351	538876.29	196.39	17603.37226	54362.35977	4908.08	615946.492
352	1165541.54	170.39	15832.43957	80269.16569	4908.08	1266721.615
353	539218.19	158.88	13454.72167	32675.02068	4908.08	590414.8923
354	1079783.66	231.89	17975.06693	33730.50222	4908.08	1136629.199
355	977707.86	127.83	13651.93918	89015.91523	4908.08	1085411.624
356	827609.69	216.56	13357.33498	90129.41036	4908.08	936221.0753
357	1388562.93	196.88	12195.38194	53648.7621	4908.08	1459512.034
358	1247897.8	153.86	15840.45886	61759.10276	4908.08	1330559.302
359	1439078.79	196.7	13930.36409	82105.95523	4908.08	1540219.889
360	1064639.96	147.79	12323.30756	28603.06473	4908.08	1110622.202
361	900815.77	223.9	16607.64916	61527.80402	4908.08	984083.2032
362	1114771.51	182.37	12293.31397	40842.95525	4908.08	1172998.229
363	803706.91	159.31	14018.39194	76673.93994	4908.08	899466.6319

364	957576.63	164.22	16626.55238	25050.43536	4908.08	1004325.918
365	1271884.14	126.49	15983.12864	66197.67995	4908.08	1359099.519
366	507201.35	225.09	15243.28756	62377.54971	4908.08	589955.3573
367	828121.11	159.23	17595.25417	92997.88377	4908.08	943781.5579
368	607408.66	163.72	16698.40894	37673.40596	4908.08	666852.2749
369	1327576.56	140.3	12542.19671	80354.77342	4908.08	1425521.91
370	712598.14	193.99	18298.36989	5986.422907	4908.08	741985.0028
371	1167448.41	170.56	11644.5756	49467.0582	4908.08	1233638.684
372	1116656.1	202.77	17720.39368	40038.65229	4908.08	1179525.996
373	1003175.99	183.05	17409.17545	70174.30757	4908.08	1095850.603
374	1035578.39	225.8	12191.99752	20130.76011	4908.08	1073035.028
375	380205.7	223.59	12541.01216	16140.39011	4908.08	414018.7723
376	1440990.18	139.64	13086.66542	28137.47338	4908.08	1487262.039
377	632929.74	130.62	13056.20227	9068.54286	4908.08	660093.1851
378	683228.86	136.35	16066.93375	82975.43075	4908.08	787315.6545
379	1029791.19	151.42	18455.7444	103784.4483	4908.08	1157090.883
380	993987.88	205.32	15518.76291	118168.2615	4908.08	1132788.304
381	1315050.72	176.52	13289.68669	123758.8699	4908.08	1457183.877
382	988606.9	191.66	18470.93257	100040.1623	4908.08	1112217.735
383	1354414.47	222.47	15814.84362	65607.92793	4908.08	1440967.792
384	1372550.68	198.58	17132.14605	13658.77896	4908.08	1408448.265
385	1325337.15	206.41	12493.65101	48066.55938	4908.08	1391011.85
386	774776.14	147.98	15785.51318	9486.284212	4908.08	805103.9974
387	908538.9	143.28	14130.59127	84971.3233	4908.08	1012692.175
388	1446792.09	152.39	16601.52358	115030.3727	4908.08	1583484.456
389	875900.64	168.36	18688.42728	75494.91215	4908.08	975160.4194
390	416607.45	176.22	18285.42376	91967.73626	4908.08	531944.91
391	1112038.44	152.76	15811.63854	60077.10505	4908.08	1192988.024
392	1398894.01	209.52	13161.66519	61212.75005	4908.08	1478386.025
393	431352.21	145.89	12401.06106	24710.20745	4908.08	473517.4485
394	1163222.17	186.45	16386.14466	4169.777759	4908.08	1188872.622
395	665911.84	177.51	14427.70376	86860.79393	4908.08	772285.9277
396	1325632.67	165.66	18714.76901	71996.30777	4908.08	1421417.487
397	898635.43	172.41	16110.00782	130903.9011	4908.08	1050729.829
398	1395818.83	132.34	16080.76162	43856.68911	4908.08	1460796.701
399	1248199.91	207.95	14112.37289	80555.34616	4908.08	1347983.659
400	693597.83	182.39	16033.31834	28012.57827	4908.08	742734.1966
401	1033134.73	143.38	13022.77514	50768.37783	4908.08	1101977.343
402	1363006.93	131.98	16689.40989	12723.6084	4908.08	1397460.008
403	1105325.32	221.78	18545.57834	46507.54652	4908.08	1175508.305
404	886908.06	126.83	16434.91693	3205.839862	4908.08	911583.7268
405	394860.82	210.4	17317.50204	36929.5709	4908.08	454226.3729
406	1216707.46	122.71	18699.82242	29431.87787	4908.08	1269869.95
407	1233273.18	205.85	13045.66806	41717.37027	4908.08	1293150.148
408	511511.2	227.01	12078.71039	30904.09565	4908.08	559629.096
409	1210704.48	198.19	11479.32972	74183.54328	4908.08	1301473.623

410	690007.96	179.47	16629.6952	62473.56198	4908.08	774198.7672
411	605570.11	241.37	12254.95307	91280.00963	4908.08	714254.5227
412	605684.06	172.45	12370.26055	108088.4338	4908.08	731223.2844
413	1113972.41	134.93	13053.03992	23831.96388	4908.08	1155900.424
414	1042766.15	188.49	14308.19816	61210.99781	4908.08	1123381.916
415	798965.67	146.54	12394.12404	29087.30106	4908.08	845501.7151
416	1106945.29	121.68	16822.01974	26225.22122	4908.08	1155022.291
417	1108668.68	147.51	13147.5533	124164.2348	4908.08	1251036.058
418	1010522.03	149.83	12403.5891	124716.4199	4908.08	1152699.949
419	1232549.88	130.86	16763.75907	63223.85696	4908.08	1317576.436
420	815369.43	194.14	16699.00914	40009.85522	4908.08	877180.5144
421	420107.36	240.45	15116.35051	76523.07621	4908.08	516895.3167
422	1010797.2	216.12	14501.49653	94639.89446	4908.08	1125062.791
423	969210.09	189.44	13592.89262	87581.98273	4908.08	1075482.485
424	1353223.81	221.37	18849.83905	43097.82652	4908.08	1420300.926
425	1355039.84	192.26	17022.96415	15376.58356	4908.08	1392539.728
426	735988.19	126.44	18412.49798	107741.6256	4908.08	867176.8336
427	1135917.69	152.14	15888.77889	37534.41611	4908.08	1194401.105
428	688129.42	133.19	18841.96959	130568.2943	4908.08	842580.9539
429	520607.89	190.57	13659.24372	89028.44392	4908.08	628394.2276
430	1203162.88	192.89	11849.29224	60431.10548	4908.08	1280544.248
431	824465.86	235.86	12665.89493	71842.11558	4908.08	914117.8105
432	512193.77	196.34	11529.83107	13621.40545	4908.08	542449.4265
433	1242853.22	152.51	14066.78404	38463.26853	4908.08	1300443.863
434	703214.07	207.68	13009.15631	83441.3846	4908.08	804780.3709
435	1271883.33	236.69	18445.95682	100427.0155	4908.08	1395901.072
436	1432627.18	164.85	17225.57852	116606.4158	4908.08	1571532.104
437	1182150.5	123.78	13168.76549	41183.44732	4908.08	1241534.573
438	1217999.78	206.82	16432.25334	15429.57542	4908.08	1254976.509
439	1318882.68	224.14	18868.25	27183.25866	4908.08	1370066.409
440	478116.66	162.96	13141.64658	111492.8733	4908.08	607822.2199
441	542498.58	202.47	17245.89088	66449.77103	4908.08	631304.7919
442	388233.18	193.7	12472.07403	107050.9447	4908.08	512857.9787
443	1075639.46	148.75	16343.75623	62850.61008	4908.08	1159890.656
444	546076.59	184.04	13126.87374	80369.80006	4908.08	644665.3838
445	473536.85	125.7	13255.07498	10289.59229	4908.08	502115.2973
446	1021851.55	131.58	12070.15916	120892.6913	4908.08	1159854.06
447	828588.92	188.42	13027.5766	48557.95883	4908.08	895270.9554
448	893439.29	127.5	13340.37583	12063.07847	4908.08	923878.3243
449	603631.7	200.92	12549.63805	36390.12998	4908.08	657680.468
450	1444514.07	150.27	13549.15818	74126.70431	4908.08	1537248.282
451	1403940.85	151.02	14572.04151	107626.7577	4908.08	1531198.749
452	989991.59	227.57	14596.39988	75295.63961	4908.08	1085019.279
453	1038677.51	132.92	15339.26863	58252.96299	4908.08	1117310.742
454	944142.09	196.99	16349.09945	26627.0342	4908.08	992223.2937
455	508755.5	237.34	14740.97313	10507.20167	4908.08	539149.0948



456	1057290.97	128.08	15685.71299	13100.5904	4908.08	1091113.433
457	543251.86	191.24	14300.00491	26964.8593	4908.08	589616.0442
458	1280538.68	233.74	15285.09965	61391.54374	4908.08	1362357.143
459	1384933.88	152.09	14049.19668	34059.91622	4908.08	1438103.163
460	1159658.88	242.73	12646.30131	62904.25666	4908.08	1240360.248
461	1035681.43	176.21	13709.64765	23748.43837	4908.08	1078223.806
462	1377203.56	166.31	13428.14132	75438.91782	4908.08	1471145.009
463	571178.1	141.04	18124.94169	120102.5162	4908.08	714454.6779
464	1076225.15	149.51	15200.51956	84293.66789	4908.08	1180776.927
465	1314213.19	123.04	13585.52149	6431.331568	4908.08	1339261.163
466	1304101.06	209.45	15092.82789	130309.908	4908.08	1454621.326
467	674701.44	143.92	13757.43322	24514.2779	4908.08	718025.1511
468	855400.16	166.69	17462.36388	76812.56811	4908.08	954749.862
469	1032417.13	147.73	18719.1871	99931.62025	4908.08	1156123.747
470	522804.12	124.96	18065.41559	79791.81704	4908.08	625694.3926
471	1316908.66	164.1	16433.64921	68961.96476	4908.08	1407376.454
472	607605.75	204.05	15908.93669	63243.85516	4908.08	691870.6718
473	700734.9	214.7	16198.00587	123365.0984	4908.08	845420.7843
474	1357775.02	242.34	12048.95849	128460.7813	4908.08	1503435.18
475	1227067.2	185.44	13425.33915	90998.95651	4908.08	1336585.016
476	472748.03	152.2	17768.74726	122892.1643	4908.08	618469.2215
477	1325027.87	175.15	16837.9421	42519.23522	4908.08	1389468.277
478	753912.91	149.99	17075.59232	59896.20331	4908.08	835942.7756
479	421699.73	235.08	16030.5067	121322.5199	4908.08	564195.9166
480	526269.41	196.15	17571.78659	87388.53891	4908.08	636333.9655
481	1042505.4	197.56	16640.10786	7450.861682	4908.08	1071702.01
482	916328.42	215.4	15130.19196	127315.6287	4908.08	1063897.721
483	1181731.03	180.03	12762.58608	23428.11113	4908.08	1223009.837
484	1399038.56	223.44	15740.96524	12958.00935	4908.08	1432869.055
485	1247898.86	124.07	12382.07363	17321.70968	4908.08	1282634.793
486	1368175.12	182.56	17248.67282	67902.6488	4908.08	1458417.082
487	1214606.34	180.51	18498.76145	98682.88648	4908.08	1336876.578
488	413418.6	130.19	14314.20677	11281.20255	4908.08	444052.2793
489	1401051.4	166.51	13550.11639	98067.93413	4908.08	1517744.041
490	1416030.45	208.65	18712.30188	74678.05753	4908.08	1514537.539
491	661980.68	200.01	18536.35978	46754.21552	4908.08	732379.3453
492	1251461.74	241.38	12584.52092	52361.99264	4908.08	1321557.714
493	1094010.17	125.69	16489.76872	40849.75426	4908.08	1156383.463
494	1232803.07	212.17	13455.3256	56390.77296	4908.08	1307769.419
495	1021068.75	152.4	18184.76657	28744.87853	4908.08	1073058.875
496	1082032.46	188.77	13406.34304	99426.20211	4908.08	1199961.855
497	581989.09	220.54	12718.77932	78085.23897	4908.08	677921.7283
498	632472.98	191.95	13609.07695	112575.5666	4908.08	763757.6535
499	460068.82	205.96	17039.93874	75618.85349	4908.08	557841.6522
500	1442937.73	175.83	11913.20999	74002.81707	4908.08	1533937.667

After 1100 iterations the Minimum, average and maximum costs are:						
	Cardboard	Electricity	Labour	Tape	Fixed costs	Total monthly cost
Minimum	372958.96	121.51	11458.82	2510.39	4908.08	403762.43
Average	924566.02	183.65	15121	66165.85	4908.08	1010944.59
Maximum	1452476.7	242.96	18876.9	131638.9	4908.08	1586863.69

## Appendix H: Monte Carlo simulation for the in-house manufacturing of cardboard boxes to use and to sell

iteration no	Cost	Income	Total monthly cost
1	4184944.199	4659820.41	-474876.2075
2	1941576.83	2376352.29	-434775.4622
3	2262571.28	3429785.27	-1167213.989
4	4251060.306	2149885.73	2101174.576
5	3155704.724	4901064.2	-1745359.477
6	4901973.783	2374481.49	2527492.29
7	1924547.969	3215039.51	-1290491.54
8	1392866.384	2579711.57	-1186845.19
9	2245758.681	1948297.33	297461.3524
10	3567668.069	1224819.25	2342848.818
11	1954728.228	1955254.7	-526.4709376
12	2291005.032	4401821.95	-2110816.916
13	1851974.312	2790801.98	-938827.6663
14	1583915.206	3901917.18	-2318001.976
15	2280886.795	2792529.05	-511642.251
16	3116102.011	4306702.37	-1190600.36
17	2685443.753	3897492.97	-1212049.216
18	3196166.886	3687299.39	-491132.5091
19	4677243.244	1733214.72	2944028.527
20	1346473.945	1766441.59	-419967.6486
21	2700823.883	4451116.21	-1750292.33
22	2979094.288	2607009.74	372084.55
23	1350076.332	2911383.12	-1561306.783
24	2235838.808	3122392.05	-886553.2414
25	3874952.184	3019823.45	855128.7344
26	1536880.128	3510861.03	-1973980.897
27	2592473.53	4439152.41	-1846678.88
28	1620600.765	2292093.31	-671492.5425
29	4843923.647	1251267.53	3592656.122
30	5095191.393	4236677.4	858513.9915
31	1683627.547	2553192.78	-869565.2349
32	1474728.952	1869861.99	-395133.0331
33	4323826.366	1947443.99	2376382.378
34	3457713.305	3182347.61	275365.6938
35	2151985.324	4581381.43	-2429396.109

36	2358023.026	4497591.86	-2139568.835
37	1886559.676	2929331.75	-1042772.07
38	3746782.281	2119868.75	1626913.535
39	3048700.937	4715768.16	-1667067.222
40	2453213.339	4131999.89	-1678786.554
41	2936284.506	2728121.67	208162.833
42	2431768.267	2634287.19	-202518.9259
43	1790353.402	2064244.26	-273890.8623
44	4858337.987	1241493.32	3616844.669
45	4923399.747	4028795.71	894604.033
46	2776070.516	1456234.25	1319836.263
47	1476555.522	3434182.86	-1957627.337
48	4032147.666	3995535	36612.66797
49	4481940.969	4486127.82	-4186.850204
50	2715382.273	1359476.08	1355906.192
51	4174625.008	2199753.93	1974871.077
52	2426771.999	3465794.15	-1039022.148
53	1466052.702	4799747.64	-3333694.937
54	2045839.867	2171875.34	-126035.4714
55	2015254.525	3472226.71	-1456972.187
56	4424756.03	1378055.39	3046700.639
57	3051355.639	4138363.15	-1087007.514
58	4645390.083	4105120.19	540269.8962
59	4935471.613	3101213.23	1834258.386
60	1975397.067	1747319.23	228077.8382
61	3549963.447	4555445.23	-1005481.782
62	3045689.686	4526036.52	-1480346.833
63	2384875.6	1337465.66	1047409.942
64	3115136.566	2735039.91	380096.6592
65	1927045.182	3292281.68	-1365236.499
66	1266887.321	4046957.37	-2780070.045
67	1277283.451	4222969.82	-2945686.369
68	1836249.677	1577263.87	258985.8103
69	3580971.225	4745414.18	-1164442.953
70	4068889.164	3865905.76	202983.3991
71	3527011.05	1304021.19	2222989.862
72	1367257.553	1855829.68	-488572.1222
73	4428602.718	4246932.14	181670.5808
74	4635374.493	1938557.93	2696816.565
75	1656908.323	2958367.74	-1301459.417
76	3654937.849	1472238.83	2182699.017
77	1693168.849	2821453.77	-1128284.923
78	2791407.576	2426591.42	364816.1574
79	2650852.728	2555170.63	95682.10119
80	3565687.139	4719836.65	-1154149.507
81	1718183.863	2673640.05	-955456.1909



82	2900405.028	1205964.61	1694440.413
83	2234872.128	2467773.74	-232901.6163
84	3664610.38	3512433.3	152177.083
85	3366222.193	4364776.88	-998554.6855
86	3932481.042	2587839.2	1344641.847
87	3455071.064	1493282.45	1961788.618
88	3326335.93	2344973.92	981362.0082
89	3263541.958	2971892.4	291649.5595
90	1812948.532	4850391.5	-3037442.965
91	3295930.911	2371965.65	923965.2574
92	1604583.752	4668076.63	-3063492.878
93	2051798.047	1388296.4	663501.6448
94	3275557.805	2963515.06	312042.7443
95	5126655.807	3017504.9	2109150.902
96	4917768.478	1559137.23	3358631.252
97	2724731.126	4398276.68	-1673545.553
98	3169924.164	3476268.46	-306344.2937
99	1956039.421	3620498.39	-1664458.967
100	4768990.211	2822411.32	1946578.887
101	3112976.334	2564477.8	548498.5295
102	3160534.746	3653102.13	-492567.3818
103	2622233.682	3876701.19	-1254467.504
104	3068468.851	2332770.76	735698.0895
105	1440596.862	3954069.82	-2513472.957
106	2936927.801	4785990.9	-1849063.098
107	4569681.297	4775411.58	-205730.2829
108	2442727.582	4661598.25	-2218870.671
109	4513774.534	4145456.56	368317.9751
110	1285584.391	3651245.79	-2365661.396
111	3947751.485	1361689.58	2586061.905
112	1893596.57	4294994.33	-2401397.761
113	2783882.388	1380396.31	1403486.076
114	2585603.476	4278956.87	-1693353.391
115	3476404.704	3491335.01	-14930.30807
116	4908716.889	1673580.25	3235136.636
117	2165639.497	1892573.57	273065.9284
118	3737684.655	2997953.81	739730.8478
119	1551153.906	3213474.12	-1662320.216
120	1755629.702	4103813.91	-2348184.204
121	3641675.439	1967530.08	1674145.357
122	4833355.595	3642201.03	1191154.561
123	1448347.98	3985074.05	-2536726.075
124	3861914.092	1942352.68	1919561.409
125	2211561.172	4913986.96	-2702425.789
126	2653400.855	3163603.54	-510202.6815
127	4109707.473	2642355.96	1467351.516

128	2782081.51	3032581.45	-250499.9371
129	3180891.331	4831999.79	-1651108.462
130	3216910.372	1905473.1	1311437.267
131	3833626.925	2147768.69	1685858.231
132	2061806.135	3535649.23	-1473843.096
133	3842521.471	4011278.89	-168757.4203
134	2441196.892	1399226.75	1041970.144
135	1649841.151	1300935.56	348905.5887
136	3241074.3	1948153.35	1292920.954
137	3891679.526	3888571.53	3107.994451
138	3212853.06	4837712.31	-1624859.255
139	2382835.275	1669735.78	713099.4914
140	3964157.877	3896001.62	68156.26071
141	2197836.459	3930908.7	-1733072.238
142	2219030.713	4348981.1	-2129950.39
143	1892674.926	2589504.22	-696829.292
144	4700437.285	1497017.91	3203419.375
145	1464139.335	2091915.82	-627776.4873
146	4682029.41	2366787.75	2315241.663
147	3778631.228	1403326.48	2375304.746
148	3018584.464	1925388.2	1093196.266
149	3584989.737	3473020.32	111969.4135
150	1977389.107	2287935.72	-310546.611
151	1456077.74	3113547.85	-1657470.113
152	5047053.377	1675697.05	3371356.325
153	1876359.163	4084266.19	-2207907.024
154	3925229.651	1384426.23	2540803.423
155	3385832.716	1193469.22	2192363.494
156	3978590.155	3365437.08	613153.0764
157	3208237.063	1932291.6	1275945.461
158	4540162.369	1718547.1	2821615.27
159	4326247.124	2113125.33	2213121.793
160	4394377.399	1789495.22	2604882.182
161	3224621.844	2093201.03	1131420.818
162	1462283.739	2042888.84	-580605.1055
163	2286120.787	2901845.16	-615724.377
164	1435903.641	1872203.16	-436299.5199
165	4819703.914	3107569.78	1712134.138
166	3186161.855	1995076.62	1191085.237
167	4857773.458	4293747.56	564025.9028
168	3502275.366	1592232.28	1910043.085
169	1864476.237	3905281.47	-2040805.23
170	3269013.939	2380532.85	888481.0886
171	1603045.086	4713258.41	-3110213.32
172	3611422.221	4902546.88	-1291124.656
173	3666414.773	3646402.69	20012.08386

174	2820511.41	2524685.69	295825.7236
175	5109849.568	3955821.23	1154028.341
176	3266390.373	3971219.53	-704829.1545
177	4681992.209	1210708.47	3471283.739
178	4012158.69	4512135.8	-499977.1082
179	3375756.103	4028101.13	-652345.0305
180	1475495.665	3618098.28	-2142602.611
181	3961140.441	2101998.6	1859141.836
182	2895567.062	4773272.02	-1877704.955
183	1554988.946	3878762.01	-2323773.066
184	1967678.139	1636204.27	331473.8669
185	2373073.096	1399382.48	973690.6189
186	4306228.548	4845332.58	-539104.0295
187	4907411.249	1838599.2	3068812.054
188	1559651.024	4863289.76	-3303638.741
189	4841448.948	1221589.41	3619859.542
190	2180481.997	3277140.71	-1096658.711
191	3973589.282	3134561.78	839027.5064
192	1708876.464	3517566.7	-1808690.235
193	3496853.348	1578847.2	1918006.147
194	1255165.26	2510100.05	-1254934.785
195	1724692.817	1194013.71	530679.1028
196	1611613.938	1378030.09	233583.8479
197	2998877.752	4647446.76	-1648569.011
198	4401360.13	1757856.99	2643503.139
199	2723970.421	3199366.07	-475395.6516
200	4208242.291	2910408.92	1297833.367
201	1650208.633	4800519.98	-3150311.346
202	1509124.827	3807103.02	-2297978.198
203	2653084.953	4477136.64	-1824051.686
204	3397531.659	2878048.9	519482.7605
205	4654076.713	4524494.58	129582.1276
206	3383735.477	2061829.67	1321905.805
207	5071787.546	2944141.03	2127646.52
208	4057842.453	3400402.46	657439.9909
209	3032668.505	3969555.65	-936887.142
210	3709600.712	3777249.73	-67649.02227
211	2480335.812	4778077.1	-2297741.284
212	3604762.812	3386585.39	218177.4218
213	3577074.852	2967060.03	610014.8258
214	3147261.614	2746585.78	400675.8339
215	3678571.148	2560836.27	1117734.874
216	2010882.678	3555671.17	-1544788.492
217	3489256.078	1615070.21	1874185.864
218	3735821.335	1811611.69	1924209.649
219	4194102.441	2346760.25	1847342.188

220	3162905.35	1208346.93	1954558.418
221	3075362.91	4031088.26	-955725.3466
222	2411891.612	2530931.17	-119039.5525
223	1779686.1	4587949.45	-2808263.351
224	4778718.872	2276961.95	2501756.925
225	2183617.593	1513419.91	670197.6809
226	2313102.613	1556382.69	756719.9203
227	2159387.351	4124347.05	-1964959.697
228	4263216.264	4651330.17	-388113.9077
229	5074218.536	3765367.09	1308851.449
230	4207537.058	1434463.19	2773073.872
231	4339596.396	3651117.32	688479.0779
232	2505743.306	2323284.57	182458.741
233	4502953.636	4071274.86	431678.7773
234	5081967.662	4784098.68	297868.9809
235	2641371.518	2532882.36	108489.1598
236	3669631.633	4431774.27	-762142.6394
237	2527446.67	2825171.29	-297724.6183
238	3322093.295	1752227.37	1569865.928
239	4823399.845	2682126.09	2141273.751
240	4425236.874	2757226.71	1668010.163
241	4052919.038	2225676.87	1827242.167
242	4759972.903	2923351.64	1836621.263
243	1929965.099	4413447.46	-2483482.357
244	4036652.869	3960055.4	76597.47026
245	4031307.697	4895846.56	-864538.8629
246	2569146.275	2075189.3	493956.9736
247	2696715.118	1283595.13	1413119.99
248	4227765.551	2210150.02	2017615.536
249	4858266.341	4418037.78	440228.5633
250	4097699.387	3058488.28	1039211.104
251	1771920.372	4748625.22	-2976704.847
252	3598934.272	1887121.09	1711813.182
253	1974680.967	4074553.39	-2099872.423
254	3974869.661	2997004.2	977865.4627
255	3675285.8	2262715.17	1412570.628
256	4255368.413	1379083.35	2876285.06
257	3476020.089	3822553.85	-346533.7651
258	3634222.723	1993403.43	1640819.293
259	3062576.239	4102623.82	-1040047.585
260	3483054.851	1654020.58	1829034.275
261	2164230.111	4841406.05	-2677175.937
262	3589038.351	2480750.98	1108287.37
263	3616860.907	4741638.65	-1124777.741
264	2989421.019	1210126.85	1779294.172
265	3398574.9	4616927.03	-1218352.134

266	5105778.326	3569725.05	1536053.28
267	2351090.168	3736526.61	-1385436.446
268	3594381.254	2456644.6	1137736.655
269	3158418.297	1491080.51	1667337.782
270	5041838.032	2606063.52	2435774.515
271	2547183.738	2564074.14	-16890.39853
272	2369213.281	4677220.94	-2308007.655
273	2062594.977	4232461.16	-2169866.182
274	3827470.3	2076279.61	1751190.69
275	2404729.86	2174470.59	230259.2746
276	3275949.579	3930190.91	-654241.3339
277	4673438.864	4187530.03	485908.8311
278	2274846.533	2090640.4	184206.1304
279	3690606.957	3525988.23	164618.7268
280	2440389.082	3607984.65	-1167595.565
281	3734618.791	2494699.86	1239918.93
282	4959149.927	4626613.92	332536.0068
283	4276386.67	1999521.5	2276865.166
284	4629013.509	3111212.56	1517800.948
285	1729337.557	1357026.54	372311.0221
286	2305931.861	1491717.39	814214.4715
287	1945962.933	2408274.66	-462311.7244
288	2964630.378	3850590.97	-885960.587
289	4507033.873	2797835.52	1709198.355
290	1599545.995	3451552.01	-1852006.016
291	3463718.454	2867902.63	595815.8189
292	3968327.876	4893291.05	-924963.1691
293	2332004.114	2982396.28	-650392.1705
294	3308390.527	2366013.8	942376.7292
295	1831097.961	2320774.1	-489676.1373
296	1702315.421	1603107.39	99208.02772
297	3136069.377	3355417.03	-219347.6488
298	3842452.204	3651832.92	190619.283
299	2495814.541	1920367.76	575446.7838
300	4020710.996	1363565.23	2657145.765
301	3579201.683	1221309.51	2357892.178
302	1873550.643	4597979.7	-2724429.06
303	2948378.083	3543208.64	-594830.5607
304	4323812.645	1922622.7	2401189.944
305	1513385.033	4358891.8	-2845506.768
306	2448165.09	3679310.56	-1231145.471
307	4934589.275	1265869.45	3668719.829
308	2572872.413	4818242.69	-2245370.277
309	1301741.926	4038277.11	-2736535.186
310	3182508.32	1554028.57	1628479.754
311	2690103.798	2006111.4	683992.3977

312	2124674.082	1398346.9	726327.1815
313	1464317.937	4242171.92	-2777853.987
314	3666700.719	3829856.16	-163155.4436
315	1582130.228	2662129.77	-1079999.539
316	4021756.495	1888908.06	2132848.44
317	2629220.66	1683315.85	945904.8062
318	4573090.485	1364971.75	3208118.731
319	3400760.412	1279388.87	2121371.537
320	3475496.176	2984880.95	490615.2245
321	4063419.146	4600485.87	-537066.7207
322	4475827.057	3643078.38	832748.6732
323	1362685.715	4267229.69	-2904543.976
324	1729168.618	3320940.53	-1591771.912
325	2028775.053	4350428.12	-2321653.072
326	1986665.115	3092026.33	-1105361.213
327	2866475.428	1687027.05	1179448.375
328	4174054.645	2865936.04	1308118.609
329	3078824.454	4672805.88	-1593981.43
330	4854990.243	3015917.99	1839072.256
331	4009885.408	3799794.23	210091.1821
332	4662608.572	4778319.97	-115711.4006
333	3945699.753	1328975.24	2616724.517
334	3503699.555	3418569.61	85129.94931
335	4300919.443	2022988.36	2277931.08
336	1826021.745	1593632.9	232388.848
337	3287579.982	2084062.31	1203517.67
338	3774513.449	2100659.42	1673854.027
339	5054692.283	1916612.17	3138080.118
340	3330992.192	1744242.32	1586749.873
341	3320141.887	3331474.84	-11332.95506
342	5022155.538	1758666.97	3263488.564
343	4511039.15	4877303.76	-366264.6125
344	2724092.916	1468643.42	1255449.491
345	1507533.198	3809604.33	-2302071.133
346	4026582.989	3267275.06	759307.9254
347	1822129.635	1553378.89	268750.7488
348	1679571.18	4246131.09	-2566559.906
349	2164969.39	2831604.01	-666634.6202
350	2140679.512	3460555.19	-1319875.677
351	3404919.965	3211436.19	193483.7754
352	1660381.077	3397661.84	-1737280.768
353	2365630.919	4063407.67	-1697776.746
354	4675824.768	4403078.89	272745.8794
355	1903178.889	1225776.89	677401.9945
356	4740429.189	1251010.37	3489418.823
357	2286958.596	3269461.68	-982503.0856

358	5001518.189	1659002.2	3342515.989
359	2154800.186	4702359.36	-2547559.172
360	4629406.767	2567417.41	2061989.354
361	2787152.26	4554988.82	-1767836.562
362	3623415.951	1784072.63	1839343.322
363	2231451.125	2672926.4	-441475.272
364	3883686.377	2400051.6	1483634.781
365	3199079.846	3474804.62	-275724.7768
366	1580565.986	3781881.39	-2201315.408
367	2582415.443	1427518.66	1154896.781
368	3812305.346	2491172.11	1321133.233
369	4683414.339	2811982.86	1871431.479
370	3852379.495	4006424.18	-154044.6816
371	4716519.328	1695940.6	3020578.729
372	1326999.358	4114228.03	-2787228.677
373	3867253.601	4821660.19	-954406.5847
374	3418426.16	2922168.95	496257.2052
375	3441854.895	2096810.99	1345043.903
376	4012341.084	1774010.95	2238330.13
377	3339460.28	4866526.75	-1527066.472
378	1865002.252	1402556.03	462446.2262
379	2397668.22	3508684.06	-1111015.845
380	2466443.527	3474202.14	-1007758.609
381	4047114.059	3763473.52	283640.5367
382	2961803.792	4004699.65	-1042895.854
383	2899484.99	2361239.71	538245.2779
384	2967359.004	3969016.57	-1001657.564
385	1452411.051	3912796.35	-2460385.298
386	1615915.615	1290683.01	325232.6025
387	1414851.698	2266402.22	-851550.5219
388	3836967.26	4474779.83	-637812.5709
389	4859778.714	1865125.87	2994652.848
390	4548294.465	2691875.17	1856419.295
391	2584230.753	1784585.69	799645.0662
392	2687176.4	1672648.76	1014527.639
393	3143021.632	4516333.13	-1373311.503
394	2109693.957	4834687.13	-2724993.175
395	4770506.882	2461004.32	2309502.559
396	2301394.437	4276102.91	-1974708.478
397	4941360.603	4240919.09	700441.5132
398	3785336.367	2342533.91	1442802.461
399	1809432.515	4097289.56	-2287857.045
400	2997840.723	4501344.76	-1503504.038
401	4846212.805	2147654.37	2698558.44
402	3581484.325	4426909.27	-845424.9491
403	3369727.216	2122902.88	1246824.338



404	3477596.723	4767235.91	-1289639.189
405	1762798.457	1268434.54	494363.9204
406	1680468.797	3133379.13	-1452910.335
407	1495799.553	3687040.04	-2191240.49
408	2092441.801	3229619.58	-1137177.776
409	2016055.047	1224773.11	791281.9348
410	4184340.109	2348301.62	1836038.488
411	2668155.557	1714616.7	953538.8591
412	4549754.747	3366129.02	1183625.723
413	1613683.207	1860545.31	-246862.1065
414	4220089.534	1953826.8	2266262.732
415	2420247.155	1945287.68	474959.4752
416	1901541.032	4008284.64	-2106743.605
417	3806361.476	3037535.29	768826.1832
418	4369250.17	2428964.81	1940285.361
419	2864190.78	3626922.91	-762732.1336
420	2291034.952	3550623.49	-1259588.539
421	4835557.065	1586529.31	3249027.752
422	3726726.073	4261309.7	-534583.6235
423	2793374.922	3503257.18	-709882.2546
424	2443205.739	3597372.62	-1154166.879
425	4613061.609	3580122.76	1032938.844
426	5027011.253	3850357.38	1176653.874
427	3131273.896	4149468.48	-1018194.585
428	1495857.657	1946577.83	-450720.1689
429	2604014.947	3472357.63	-868342.679
430	3282526.989	4179199.42	-896672.4333
431	3579783.764	4481417.2	-901633.4326
432	3282998.109	3860317.2	-577319.0956
433	4646784.206	2157869.9	2488914.311
434	3912117.241	1760234.8	2151882.444
435	3077550.319	3978409.43	-900859.11
436	2590632.963	3332698.8	-742065.8419
437	2881158.112	4263699.66	-1382541.55
438	3080415.923	1751991.2	1328424.722
439	3110768.216	3601550.99	-490782.777
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441	5081821.273	4142221.32	939599.9499
442	3082801.09	3593066.44	-510265.3514
443	3245478.555	1721697.16	1523781.394
444	1980525.905	2250757.58	-270231.6766
445	1436583.448	1573081.52	-136498.0692
446	1250398.239	3515053.39	-2264655.152
447	2325749.364	4714373.65	-2388624.289
448	1860607.432	4847956.27	-2987348.839
449	4908364.303	3782812.27	1125552.028



450	2780526.404	4347678.92	-1567152.517
451	4922296.125	3676247.2	1246048.921
452	2909426.768	3530693.29	-621266.5177
453	2608366.724	4843281.21	-2234914.487
454	3681514.161	4924487.99	-1242973.833
455	5123077.799	1409286.67	3713791.134
456	2539132.8	1316743.29	1222389.51
457	2791683.295	2336330.83	455352.4677
458	2558945.879	3179314.05	-620368.1719
459	4546622.575	3638684.11	907938.4692
460	5064792.211	3828730.39	1236061.824
461	1800945.174	2176443.38	-375498.2098
462	4223393.217	1360962.09	2862431.128
463	5099485.123	4035798.41	1063686.713
464	3164601.982	4783760.67	-1619158.685
465	2070899.832	2875485.58	-804585.7517
466	4292288.781	2699149.62	1593139.156
467	3796730.519	2230373.43	1566357.089
468	3883169.004	2656294.59	1226874.412
469	4087369.708	2199208.3	1888161.405
470	3742362.088	1763114.95	1979247.135
471	3194844.113	4725834.72	-1530990.608
472	3674577.627	2564171	1110406.625
473	2190267.668	2761065.69	-570798.0225
474	2765481.102	3329555.69	-564074.5838
475	4077238.565	2162990.85	1914247.712
476	5041780.902	4152549.4	889231.5037
477	4344266.445	3121847.03	1222419.413
478	4059797.934	4573253.04	-513455.1051
479	1797561.169	2249162.45	-451601.2841
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481	3190976.971	2820664.24	370312.7278
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483	3727516.012	3577927.89	149588.126
484	4075501.669	2262109.86	1813391.806
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487	3929830.811	2958366.23	971464.5795
488	4608213.647	4655174.06	-46960.408
489	5068851.885	4671157.39	397694.4983
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491	2360644.876	2008643.89	352000.9836
492	3133327.863	3376031.99	-242704.1248
493	4705548.717	3779696.21	925852.5081
494	1283375.555	3353030.44	-2069654.889