Development and Analysis of a Facilities Layout to Accommodate New Machinery Purchased to Reduce Reliance on Outsourcing

by

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Submitted in partial fulfilment of the degree of

BACHELORS OF INDUSTRIAL ENGINEERING

in the

FACULTY OF ENGINEERING, BUILT ENVIRONMENT AND INFORMATION TECHNOLOGY

UNIVERSITY OF PRETORIA
PRETORIA

October 2008

Executive summary

The study of K&M Signs in terms of the facility layout and outsourcing has yielded significant results. The economic study of the outsourced products and quantities illustrates the capacity for increased profits through the investment in a digital printer and crane truck with a loan that will be settled over a five year period.

A stainless steel welding process put in place to complete K&M Signs' succession of welding skills proves to be aptly advantageous. Investment in a digital printer will complete K&M Signs' capacity for producing signage and assist in providing a complete service to any customer. A crane truck, on the other hand, will decrease the company's dependence on third parties, improve lead times on projects requiring large installations and save the company money.

The investment in these facility instruments requires equal consideration for the facility and its layout. With this said, the most advantageous facility plan has been established and sufficiently analysed. The new layout that has been developed will offer equal benefit for K&M Signs, should K&M Signs choose to implement the changes and adjustments. The improved layout will ensure that the improved products and product range are supplied in a more timely manner and are of better quality. The benefits additionally include improved material flow, better space utilisation and improved departmental shapes, to name a few.

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1. Introduction and background

K&M Signs has two factories – one situated in Johannesburg, Gauteng and the other in Pinetown, KwaZulu-Natal. This project is focussed on the Johannesburg factory.
K&M Signs is a competitive and well established signage company that undertakes work both nationally and abroad. The company has three directors, and a company called Jungle Arrow which has a 30% share in the Natal branch. The two factories share some resources and projects but each factory sources its own clients.

The following documentation is a detailed explanation of the measures that will and have been taken to resolve the problem of excessive outsourcing by K&M Signs.
The document includes:

- an in-depth review of literature related to the project
- identification of tools, methods and techniques required to address the various challenges of the project
- selection of the best-suited approach
- data and information collection and analysis of the project environment
- the initial conceptual solution and
- application of approach and best-suited solution.

The project is clearly defined in this document and all methods and required information is defined and presented. This will provide the necessary means to select the optimum alternatives and ultimately solve the problem.

The project consists of the development of a new facilities layout to accommodate proposed new machinery purchases with the intention of reducing outsourcing. Currently, K&M Signs outsource the following functions:

- Screen printing
- Digital printing
- Laser-cutting of hard metals
- Stainless steel welding
- And additionally, they also need to hire a crane truck every time they install a new pylon

Each piece of the proposed new equipment is thoroughly analysed to identify the equipment best suited to the company. Economic studies have been completed to determine the best choice of the available equipment and whether or not it will be beneficial to purchase the equipment. Finally, the facility layout must be redesigned to accommodate the new equipment.

This report will first examine literature relevant to the project and outline the measures required to arrive at the best possible solution. Tools, methods and techniques chosen will be highlighted and discussed with the purpose of conveying the relevance and advantages to all stakeholders in a comprehensive manner. Relevant data and information essential to the project will subsequently be presented, providing a foundation for the project. Alternative procurement options are developed and the best alternative is selected ensuring that the procurement is beneficial to the company. The facility layout alternatives are then explored with the aim of identifying the best layout for K&M Signs and accommodating the new equipment. The best-suited solution is then presented in a convenient and vivid manner.

2. Project aim

The aim of the project is to:

- Determine whether K&M Signs can save money by investing in equipment that will help them reduce their reliance on outsourcing and therefore increase profits.
- Redesign the factory floor to accommodate the new machinery (keeping in mind that Health and Safety must remain up to standard, and that maintenance planning will have to be implemented and/or improved).

3. Project scope

The scope of the project includes the information gathering and analysis thereof, the selection of the best-suited equipment and processes, development of the optimal and most cost effective layout and an implementation plan. Once complete, K&M Signs should be able to identify the cost benefits and if adequate, begin implementation without any further analysis.

4. Literature review

4.1 Introduction

The following research is a study of topics, methods and tools relating to procurement and facilities planning and is applicable to the project topic. In the research, information has been collected and presented for the purpose of aiding in the completion of the procurement and development of a facilities plan for K&M Signs. Whilst many of the topics, methods and tools may have other components to them, only material relevant to the project is selected. The research defines relevant terms where necessary and aids in the understanding of this report and the project as a whole. It also identifies relevant tasks and explains the approach that will be used in the project.

Initially, procurement is discussed and significant components are outlined. These components are important parts of procurement and will aid in the selection of the machinery best suited to K&M Signs' needs. Once the best methods for equipment identification have been identified, selection of a specific machine for each requirement is made. This will be done by finding machinery best suited to the job with the lowest product cost and life cycle cost (LCC). This is the second topic discussed.

Maintenance is vital to ensure that the new equipment performs optimally and to ensure that the equipment reaches its projected life span. The maintenance plan that is selected will have an impact on the LCC and therefore the maintenance plan must be selected prior to the analysis of the LCC. The different types of maintenance plans will be discussed and the best one for this application will be selected.

Once it is clear what sort of equipment is to be used, a facility plan is developed. In order to find the best possible layout, planning options and tools are considered and selected.

4.2 Procurement

Before procurement methods and analysis can be researched, selected and implemented, a clear understanding of procurement and what it entails is required.

The terms “procurement” and “purchasing” are often used interchangeably. These terms usually both refer to the process that is undertaken by a company, where the company will enter into contracts with third parties to acquire goods and services that they require to fulfil their business objectives. These actions are carried out in the timeliest and most cost-effective manner. It should however be pointed out that purchasing may imply that the company seeks to form an ongoing commercial relationship with the third parties (Quayle, 2006).

Procurement is a broad term and incorporates a number of measures, many of which are vital, that need to be fulfilled before the final equipment selection can take place. The following aspects of procurement have been identified as vital for the completion of this project:

- Need for equipment, including the origin of the need and the reason
- Alternatives analysis
- Justification
- Product cost

It is also important to consider the effects of the technology push verses the market pull and benchmarking, as described by W. Peters in his thesis “Optimising procurement by the use of technology management principles”.

4.2.1 Need for equipment: Origin of the need for equipment

Once it has been determined that a specific piece of equipment is required, it is important to identify the origin of the need (Peters, 1998). This need may be for a specific item or may be a requirement of a system or process where the equipment has yet to be identified.

Possible origins of the need for equipment that are applicable to the case in question are:

- new activities
- benchmarking
- new manufacturing processes.

For K&M Signs, a new activity is the branding of vehicles. In the past this has been undertaken on a relatively small scale. The company offers vehicle lettering at present. Because the company does not currently have a digital printer, the branding of an entire vehicle or fleet of vehicles is costly and time consuming. Should it prove practical to purchase a digital printer, vehicle branding will become more feasible as each vehicle can simply be covered with printed vinyl, instead of cutting individual words and pictures out of vinyl.

Benchmarking is the process whereby the best practices of the industry and other industries with similar processes are identified. This can be the best practiced process, service delivery and/or product creation. Benchmarking is used to identify and evaluate where the company stands in terms of performance improvements (Peters, 1998). The process of benchmarking entails:

- understanding, in detail, existing processes
- analysing the processes of others
- comparative analysis of own processes with others
- implementation of necessary steps to close the performance gap.

New manufacturing processes are continually developed, and it is important for an organisation to be aware of these processes. Furthermore, while a small to medium enterprise (SME) may not be able to justify the cost of many new manufacturing processes, these processes are continually developed and many cases become more cost effective as time lapses. While laser cutting started gaining popularity over 25 years ago (Lindsey, 2004), it has been continuously improved and is now a viable choice for many SME's.

4.2.2 Need for equipment: Reason for the need for equipment

Procurement is a means of, amongst other things, identifying and justifying the purchase of equipment for the purpose of maintaining acceptable standards and improving competitive advantage. An important step in the justification of the procurement is identifying the reasons for the need for equipment. The first reason for the need of equipment is improvement.

Improvement may be required in order to achieve:

- greater versatility
- higher output and quality
- and to reduce lead times.

Versatility refers to the ability of an organisation to do many things well. For K&M Signs, the procurement of a digital printer and a laser cutter will definitely increase the versatility of the company. Higher output and quality will usually be achieved when implementing new machinery and new technology; it is important to ensure that the output and quality is in line with or exceeding market requirements.

Lead time is the period between a customer's order and the delivery of the final product. Currently K&M Signs outsources many items; this means that they must place the order with their supplier, wait for the parts to be produced and then wait for the parts to be delivered. Furthermore, if there is a problem with the parts, the process must begin again. This process can cost the company valuable time, increasing lead times and inventory, which inevitably costs them money.

Another factor identified as a reason for the need to procure equipment is expansion. A company may decide that the expansion of their activities will increase turnover. These new activities may require machinery other than those in operation, or additional machinery to cope with demand.

The final reason applicable to this case is opportunistic. This refers to the existence of special sales opportunities.

4.2.3 Alternatives to procurement

Finding the best option for procurement must also include alternatives to procurement. If the best procurement option is found and the selection process does not include or consider the “do nothing” option or any of the other alternatives to procurement, the analysis is flawed and will not yield the optimal result. This can have catastrophic effects on a company and it may take many years to recover.

Alternatives to procurement include (Peters, 1998):

- do nothing
- sub-contracting
- process redesign
- abandoning the project/s
- selecting an alternative project
- leasing instead of purchasing
- and resurrecting and overhauling.

4.2.4 Equipment leasing

There are a number of advantages that are associated with equipment leasing. Some of these advantages are:

- less capital required
- less risk of obsolescence
- maintenance may be provided by supplier
- equipment may be returned to the supplier at the end of the lease agreement, should the equipment/product become redundant.

The leasing of equipment will usually cost a significant amount more than purchasing, despite these advantages.

4.2.5 Justification

All alternatives, including those requiring little or no procurement, must not be evaluated. It is important to first set up a table of alternatives and ensure all alternatives are clearly defined. Defining the alternatives will identify and help ensure that any “grey areas” are dealt with and overcome. The feasible alternatives will be assessed according to a number of predetermined criteria. Determining the criteria for evaluation before hand will assist in the removal of any bias decisions. The criteria will also take into account all factors of a company.

To identify the important criteria, the company’s value chain must be profiled (Humphreys et al, 2000). This is done by looking at the core activities of the business

and benchmarking it with the industry and possible other industries, depending on the specification of the industry.

Once the criteria are clearly defined, alternatives are analysed using a total cost analysis. The type of cost analysis will form part of the criteria. This analysis should include:

- investment cost
- installation cost
- operation cost
- support cost
- and maintenance cost.

This will be discussed in more detail later.

4.3 Economic analysis and life cycle cost (LCC)

4.3.1 Alternatives description

Alternatives are stand alone options of the various equipment combinations that are to be considered (Blank & Tarquin, 2004). These alternatives must be described thoroughly, providing the best possible estimates of the parameters that limit the equipment. As stated previously, cleverly defined alternatives will assist in better decision making.

To decide between those alternatives, estimated cash flow of each alternative will be vital.

4.3.2 Economic analysis of alternatives

There are many means of economic analysis of alternatives, most of which depend on the type of project. To determine which method will be used, it is important to recognise specific characteristics of the alternatives. Mutually exclusive projects are those that compete with one another. This means that the selections of one alternative will automatically mean the rejection of the other projects. In the procurement of the

equipment the different types of equipment are not mutually exclusive, although different makes of the same equipment with the same function are. Independent projects, where projects in this case would be the procurement of each piece of machinery, are projects where the selection of one alternative has no effect on the other decisions that must be made.

The procurement of the equipment and associated alternatives are revenue alternatives as they include cash flow estimates and possible savings.

4.3.3 LCC (Life Cycle Cost)

Life cycle cost analysis is based on present worth analysis. It is most effective when a substantial amount of the total costs of the system are operating and maintenance costs (Blank & Tarquin, 2004). These circumstances are yet to be elevated; however the cost of operating the crane truck and materials costs are high.
Significant costs are committed at an early stage as a result of equipment selection and design requirements; however these costs are only paid for when the equipment is put into service (Quayle, 2006). For this reason, it is important to review life cycle costs as early and as thoroughly as possible.

4.3.4 Total cost

The total cost is a combination of both fixed costs and variable costs. The following costs will be included in the total costs of procurement and the equivalence calculations:

- Total maintenance costs
- Total production costs
- Initial costs of machinery

4.3.5 Inflation

Inflation is an important part of a project such as this one. Inflation figures will be obtained from the Department of Finance as the department publishes forecast inflation figure for the next 3 years.

4.4 Strategic maintenance

Maintenance is an integral part of this project. New equipment will age faster than usual if it is not maintained correctly and this will give rise to many problems such as regular breakdowns, defective parts, increasing down time and unreliable output. All of this aside, the consequences on a procurement project such as this one, will be evident when maintenance cost exceed the estimates, the predicted life of procured machinery is not reached and production figures are not reached.

The total cost analysis of the new equipment is therefore only valid if the equipment reaches its quotas and survives for its entire lifecycle. Furthermore maintenance is a significant portion of the total operating cost. Therefore it is imperative that a maintenance plan is in place when the equipment is put into production. Maintenance requires a multidisciplinary approach where it is viewed strategically from a business perspective (Murthy et al., 2002). The following important features must be included in the approach:

- Quantitative approach with contributions from economic and mathematical models
- Collection and analysis of all relevant information
- Continuous improvements

K&M Signs uses a relatively low amount of machinery as the operations of the business are labour intensive. Mechanisation is out of range for this small to medium enterprise (SME). The technical difficulty of mechanisation in this job shop – cellular manufacturing environment and the capital required both limit the company to labour intensive processes. This means that there is little equipment requiring maintenance programmes. This has resulted in the company using what can be described as a combination of run to failure (RTF) and corrective maintenance (CM) programmes.

The new equipment will require a more comprehensive maintenance program, although a relatively simple maintenance plan will be sufficient. This is because even with the procurement of the new equipment, the process will remain labour intensive and machinery will continue to have idle times giving staff the opportunity to do maintenance.

Types of maintenance will now be analysed in order to select the best suited to K&M Signs' needs. The maintenance programmes are as follows:

- Corrective Maintenance (CM)
- Run To Failure (RTF)
- Schedule Maintenance (SM)
- Preventative Maintenance (PM)
- Predictive Maintenance (PdM)
- Total Productive Maintenance (TPM)

4.4.1 Corrective maintenance (CM)

Corrective maintenance is a result of primitive techniques where maintenance is regarded as an unavoidable cost. The equipment is run till a failure occurs then a specialized workforce is contracted to restore the system to operation. Maintenance is not incorporated into the design and the impact of continuous maintenance is not considered (Murthy et al., 2002)

4.4.2 Run to failure maintenance (RTF)

RTF maintenance is the result of the mindset "if it isn't broken, don't fix it" (Gutierrez, 2000). The maintenance only takes place when the equipment performance is unacceptable. In essence RTF is very similar to CM with the difference that maintenance may be planned for by allowing space for maintenance worker and that defective / poor quality parts may initiate maintenance. This technique can result in large downtimes at the most inopportune times.

4.4.3 Scheduled maintenance (SM)

SM uses a predetermined maintenance scheduled that uses intervals calculated on post experience of the machines/ equipment reliable and updates. The disadvantage of this method is that the schedule is calculated on averages and failures may still occur before the scheduled maintenance. The figures for SM can also be hard to obtain for a number of reasons, such as:

- New machines have no post history
- Less machinery means less information
- Different machines require different maintenance schedules

4.4.4 Preventative maintenance (PM)

PM uses restorative maintenance action prior to failure. The strategy incorporates the actions of lubrication, servicing, overhauling, inspections, adjustments scheduled replacements and cleaning to maintain a desired level of performance. Poor repairs and maintenance practices may cause premature failure and may damage equipment.

4.4.5 Predictive maintenance (PdM)

The monitoring of equipment performance can be used to recognise eminent failure. This requires lots of analysis and data collection and will not be an option at K&M Signs.

4.4.6 Total productive maintenance (TPM)

TPM gets the equipment operator involved in the active maintenance of his/her equipment, encouraging the operator to handle basic maintenance tasks such as; to keep his equipment clean, well lubricated and enables him to recognise and report the onset of failure or deviation from normal. There are other aspects to this technique; however this will be sufficient for K&M Signs.

The maintenance programme that will be planned and used to maintain the new equipment at K&M Signs will be TPM with scheduled maintenance planned for the larger maintenance work, such as replacement of complex parts and overhauling. These scheduled maintenance actions will be outsourced if the equipment supplier does not provide the services.

This maintenance plan will be used when calculating maintenance costs, operating costs and lifecycle costs.

4.5 Facilities plan

K&M Signs has a limited budget and cannot afford to build a new structure or move location. A new facility layout will be the best option. The main objective of the new layout is to accommodate the new machinery, improve material flow, decrease WIP and increase manufacturing lead times. Keeping this in mind, the following facilities planning tools and techniques will be relevant to the project.

The traditional facilities planning process involves the following:

- Define the problem, including objectives and both primary and supporting activities of the facility
- Analyse the problem, whereby the interrelationships of all activities are determined
- Determine spatial requirements of all materials, equipment and personnel
- Generate alternative designs. In this case alternative layout will be developed
- Evaluate alternatives by ranking them according to chosen criteria and determine the affect on the operations of the facility
- Select the optimum design
- Implementation plan

4.5.1 Product analysis

To determine the objectives and activities involved in production, it is vital to determine the specific activities required for all major product groups. This involves specifying product groups that contain products manufactured in the same and similar way to others in the group. Assembly and operation process charts will help to accomplish this goal. Once these requirements have been found, an activity relationship diagram can be used to map the relationships of specific departments. This is required because of the nature of the product produced by K&M Signs, whereby the production of unfamiliar products is a regular occurrence.

In order to analyse the relationships between the different departments with respect to space, flow and activity relationships, it is important to understand the following:

- Nature of the products and their relationship (discussed above)
- The manufacturing cells used in the layout
- Spatial requirements of manufacturing cells and departments
- Flow between manufacturing cells

Product families are grouped together based on similar manufacturing operations or attributes. Machines required to manufacture each of these part families are grouped together to form manufacturing cells. Flow and space requirements are determined by lot sizes, storage systems, equipment type and the layout arrangements, amongst other things. “From-To” Charts sum up travel distances and present flow data in a readily available format. These charts are dependant on flow patterns which should be identified for each layout alternative.

4.5.2 Materials handling

Materials handling system design and the layout design are inseparable (Tompkins et al., 2003). Although this is the case, it is more applicable to the design of new facilities and facilities with large batches, it is important to keep in mind the principles of material handling when designing the facility layout. The ten principles of material handling are as follows:

- Material handling planning
- Standardisation
- The work principle, which is volume or weight multiplied by the distance moved
- Ergonomics
- Unit load principle
- Space utilisation in cubic meters
- System principle
- Automation principle
- Environmental principle
- Life cycle cost principle

Many materials handling check lists have also been developed and provide a simple yet effective way of checking and improving materials handling systems.

4.5.3 Layout planning

There are four basic layout types, namely:

- production line product layout
- fixed product layout
- product family layout
- process layout.

As the facility being reviewed is a flexible manufacturing system (FMS), the process layout is applicable. Finding the best layout option is dependent on the information gathered. There are many factors involved in establishing the layout plan, many of which can have a significant effect on the outcome. Quality and extent of data collection must be thoroughly examined.

5. Tools, methods and techniques selected for the project and the development of conceptual solution

The project involves three specific areas in which the application of particular concepts must be used. These are:

- procurement techniques
- economic analysis
- facilities planning, specifically layout planning.

5.1 Procurement techniques

Procurement requires the understanding of the manufacturing system and its many processes in order to ultimately justify the large capital investment. The following aspects must be thoroughly analysed:

- the need for equipment
- alternatives generation and analysis
- justification
- product cost and total cost to company.

5.2 Economic analysis

Economic analysis will be required in both the selection of the correct equipment and in determining the cost of the implementation of the equipment, including whether or not continuing to outsource would be the best solution. To select the correct equipment alternative, equivalence calculations will be employed. Once this is done, a facilities layout can be generated, refined and planned, ready for implementation.

5.3 Facilities planning

Facilities planning requires that the relationships between machinery, manufacturing cells, materials and space requirements are understood and quantified. The activities required for all major product groups will be found by determining the best way in which to group and classify products and then producing an activity relationship chart. A “From-To” chart will help define space and flow relationships by considering both distances and

the rate of recurrence of the movement between departments. Specific tables and spreadsheets have been developed to analyse certain predetermined feature of the facility layout. These tables include spatial requirements and allocation, proximity analysis and aisle characteristics. Finally, materials handling principles and materials handling checklists will ensure a steady material flow within the new layout.

6. Data collection

The accuracy and relevance of this project will be determined, for the most part, by the quality of the data collected. It is therefore imperative that sufficient and relevant data is collected. For this reason, the data requirements have been defined and examined for availability, quality and significance.

For the purpose of the equipment procurement, the following data is required:

- outsourced quantities
- outsourced prices
- outsourced part lead-times
- materials dimensions and equipment requirements.

To obtain the information about outsourcing, the persons in charge of the creditors accounts (the creditors clerk and accountant) were consulted, some creditors accounts are examined and management accounts were reviewed.

6.1 Outsource prices

The price estimates received from K&M Signs are:

Table 1: Current outsource estimates

Product/Service outsourced	Price per unit
Crane-truck hire	R 3 300.00 per day
Digital printing	R 250.00 per m^2
Laser cutting	R 230.00 per m^2
Screen printing	R 125.00 per m^2

These values are extremely difficult to determine, as the prices are dependant on many factors. These factors include the type of material used, the thickness of material and the complexity of design etc. Different suppliers also have different prices and quoting systems.

6.2 Outsource quantities

In response to a request for outsourcing information, the following information was provided:

Table 2: Average monthly expenditure

Product/Service outsourced	Average monthly expenditure
Crane-truck hire	R 50 000.00
Digital printing	R 20 000.00
Laser cutting	R 1 000.00
Screen printing	R 10 000.00

This information is deceiving and warrants further investigation. For 2008, the crane truck expense was inflated due to a number of long distance deliveries and installations. It is found that in 2008 two deliveries were made to Namibia, two to Botswana, two to Zambia, two to KwaZulu-Natal and two to the Zimbabwean border. Previous years yielded an average expense of R 8 000.00 per month. The information supplied by the accountant for each product/service outsourced is a rounded average taken over the period of 1 year.

Laser cutting has not been used much in the past and many of the current laser cutting jobs have not been invoiced and were not included in the accountant's statistics. Softer metals and Perspex™ are cut on the router or by hand which is time consuming, expensive and often leads to unexpected breakdowns and high levels of scrapped material. The result of this is that not all jobs that would be done on a laser cutter have been recorded.

The quantities in units of outsourced services are found using the information in tables 1 and 2. These figures are:

Table 3: Average monthly quantities

Product/Service outsourced	Average monthly quantities
Crane-truck hire (R 8 000.00 pm)	3 trucks hired/month (each for 1 day)
Digital printing	80 m^2
Laser cutting	4.5 m^2
Screen printing	80 m^2

6.3 Outsource lead times

The time between the placement of an order and the delivery of the product or part varies according to batch size, detail, finish and many other factors. A truck can usually be arranged by the morning of the next working day. Lead time of truck hire is therefore not an issue. Laser cutting takes 4 to 5 working days, as does screen printing. Digital printing usually requires only a hand full of prints, where one print can be done the same day and 5 to 10 will take 1 to 2 working days.

6.4 Inflation

Inflation and prime rate figures obtained from the South African Reserve Bank are:

Table 4: Rates as of April 2008

Inflation rate (CPIX)	Prime rate
10.4%	11.50%

These figures will be updated prior to the economic analysis.
The relevance of this information is that the inflation rate will be used to calculate the depreciating value of money (often referred to as the time value of money) and the prime rate indicates the price of money borrowed.

6.5 Materials dimensions and equipment requirements

The materials that K&M Signs use are readily available and come in standard sizes. The laser cutter will be used to cut sheet metals such as stainless steel and various grades

of aluminium sheets. Brass sheets are also used from time to time and large numbers of Perspex™ sheets are also cut. The metal sheets have a standard size of 1.25m x 2.45m and vary in thickness. K&M Signs use relatively thin metal sheets, which don't exceed a thickness of 5mm. Perspex™ sheets come in a standard size of 1.8m x 3.2m, with a thickness no greater than 10mm.

Laser cutter

The laser cutter will need a bed width of at least 1.8m if it is to be used for Perspex™ and metal or a bed width of at least 1.25m if it is to be used with only metal. The screen printer is used to print specific images on large product batches of metal, wood or Perspex™ and will also have to accommodate parts up to 1.8m wide.

Crane trucks

Generally, crane trucks are hired from any truck hire company with competitive prices and short lead times, as long as the truck meets the following criteria:

- Minimum 7.5 meter bed length
- Hook height of 9.5 meters
- The crane must be behind the cab
- 4 meter radius
- And a 1.35 ton bed load

These criteria will be used to establish the price of a new truck.

Digital printer

The digital printer prints on vinyl, which is a thin film of plastic with an adhesive layer on one side. The standard gauges are 0.001, 0.002 and 0.005 inches thick and there are variations of these products that can be stacked and laser cut. The standard width of this product and the width that K&M Signs uses is 1.2m wide. Therefore, the digital printer must be able to accommodate this.

Facilities plan

For the purpose of the facility plan, the following data is required:

- dimensions of the factory
- the number and dimensions of manufacturing cells, as well as details and functions of these cells
- dimensions of the old and new machinery
- core competencies and core activities
- adequacy of costing system
- factory layout description.

General factory dimensions are obtained from the site plan, while the work stations are measured out. The following table lists the sections of the factory and provides dimensions.

Table 5: Facility dimensions

Department	Section	Length (m)	Width (m)	Height (m)
Neon department		4	8	3
Router room		7	5	3
Clean room	Paint	10	5.2	4
	Drying area	10	1.5	4
Vinyl department	Cutting	3.5	5.45	3
	Storage	3.5	2.2	3
	Application	5	20.8	3
Wiring department		10	10.4	7.5
Sheet metal		20	9	7.5
Perspex™ department		20	9	7.5
Assembly area		10	9	7.5
Welding station		18.2	10	7.5
Storage area		10	9	7.5
Moulding department		5	7.8	7.5
Cleaning bay		10	4	-
Carpentry		5	3	2.7

The factory has an open plan with no dividers or barriers between the manufacturing cells. Only the Neon Department, Vinyl Department, Router Room and Clean Room have fixed positions. The Vinyl Storage and Vinyl Cutting Departments are on the second floor and the Neon and Vinyl Cutting Departments are in the same area of the building as the offices.

Figures 1 and 2 show a basic layout plan of K&M Signs' current layout. (Not to scale)

Figure 1: 1st Floor

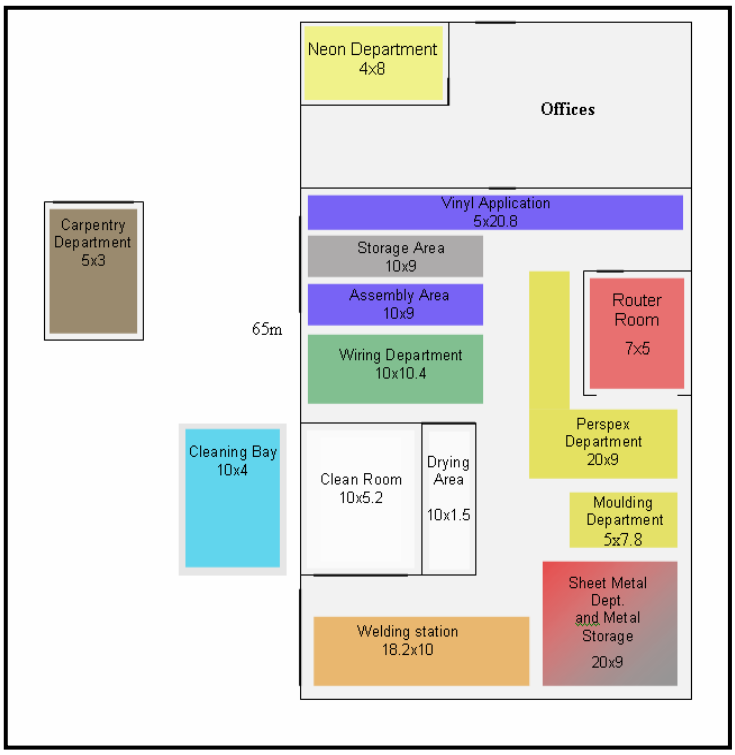
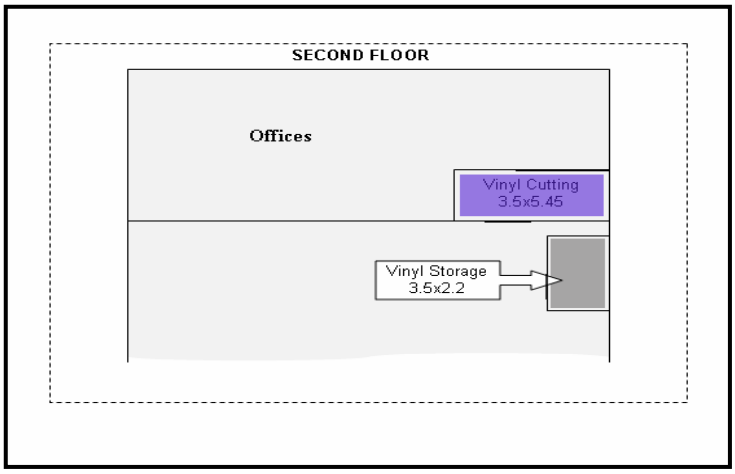


Figure 2: 2nd Floor



The sources of the information provided in this section can be found in the appendices. Appendix 1 contains an email received from K&M Signs that includes monthly expenditure and quantities outsourced. Appendix 2 contains a few costing sheet examples, while appendix 3 contains faxed information including crane truck quotations, laser cutting price lists and other estimates. Appendix 4 contains the K&M Signs Materials Pricelist Spreadsheet.

7. Data analysis

7.1 Procurement

The following aspects of procurement have been identified as vital for the completion of this project:

- need for equipment, including the origin of the need and the reason
- alternatives analysis
- justification
- and product cost.

7.1.1 Origin of the need to procure

The origin of the need for each piece of outsourced equipment has been identified and is described below.

For the laser cutter, the need originated from the inability of the router to quickly and effectively cut sheets of metal. The problems include: slow cutting times, cutting tool breakages and subsequent scrapping of work piece, increase in router breakdowns due to the strain on the machine and poor finish and accuracy. Laser cutting, while not an altogether new technique, is becoming a viable alternative because of the advances that have been made in this technology.

Screen printing is a technique whereby an image is transferred onto a mesh screen using a photosensitive chemical and a UV light source. This image can then be transferred to vinyl, metal or a painted surface using the appropriate ink or dye. Once the screen has been produced, it can be used repeatedly to transfer the image or graphic to an almost endless amount of parts. Screen printing is an old technique that has been improved a great deal over the past years. However, this being said, the machinery and equipment are expensive and large numbers must be produced to justify the investment. Digital printing is a much better option for lower quantities. Therefore, the need for digital printing has originated from the development of digital printing as an alternative to screen printing.

The crane truck is required as it is the best option for the installation of large signage. The procurement of this piece of equipment may be a viable option as a result of the increase in quantities of the large signs.

Stainless steel welding is simply a process that has been overlooked, while developing the skills of employees. This process is no more complicated than aluminium welding which is done in-house.

7.1.2 Reasons for the need to procure

The reasons for the need to procure include: improvement of facility and processes, expansion and opportunistic needs. Types of improvement required can be for an improvement of versatility, improvement of output and quality, improvement of lead times or any combination of these reasons.

The reasons for the need for the laser cutter, digital printer, screen printing process, crane truck and stainless steel welding process can be described as predominantly improvement needs.

The laser cutter is required to improve versatility by allowing K&M Signs to:

- cut multiple layers of vinyl and/or Perspex™ simultaneously
- cut a variety of hard metal sheets in-house and drastically reduce lead times
- expand services by offering laser cut parts as another service (this is an opportunistic improvement).

The laser cutter will also improve the quality of metal products usually cut on the router.

A digital printer will provide the following benefits:

- expand services by offering vehicle branding as an improved service (this is an opportunistic improvement)
- improvement of cycle times by reducing the number of layers of vinyl required for each sign
- reduce lead times.

The advantages of introducing a screen printing process are:

- it is a cheaper alternative to digital printing, however, large quantities are required to justify the large capital investment and it requires long setup times
- as with digital printing and laser cutting, screen printing can be offered as a service on its own.

The reasons for the need for the crane truck are result of economics, better planning and investment in the future. As the demand for large signs and pylons increases, the need to purchase a crane truck increases. This is because the cost of a truck is justified by the amount spent on renting a truck. Purchase of a crane truck will also improve versatility and lead times.

Stainless steel welding is a process that should be done in-house. In this job-shop environment, there are many situations that can arrive that may require large quantities of this type of welding. Outsourcing will increase costs and lead times and may necessitate that employees produce a sign that is not of the best quality. Stainless steel welding will:

- improve versatility
- reduce lead times in certain circumstances
- improve quality
- may expand the range of products.

7.1.3 Alternatives generation

In order to generate all possible alternatives, the alternatives to procurement have been identified for each piece of equipment. This is due to the fact that alternatives to one product may not necessarily be an alternative for another. A table has been set up to assist with this task. Table 6 marks the relevant alternatives with each type of equipment.

As previously mentioned, these alternatives include:

- do nothing
- sub-contracting
- process redesign
- abandoning the project/s
- selecting an alternative project
- leasing instead of purchasing
- resurrecting and overhauling.

The table includes the purchase and purchase on credit options.

Table 6: Feasible alternatives

	Laser cutter	Digital printer	Screen printer	Crane truck	S.S. welding
DN	■	■	■	■	■
SC	■	■	■	■	■
PR		■	■	■	■
AP	■	■	■	■	■
SA	■	■	■		
LI	■	■	■		
RO					
PO	■	■	■	■	■
PC	■	■	■	■	■

Name	Key	Name	Key
- Do nothing	DN	- Leasing instead of purchasing	LI
- Sub-contracting	SC	- Resurrecting and overhauling	RO
- Process redesign	PR	- Purchase only	PO
- Abandoning project/s	AP	- Purchase on credit	PC
- Select alternative project	SA		

These alternatives are defined as:

Do nothing: take no action to fulfil the need for a specific machine/process.

Sub-contracting: this is essentially the same as outsourcing the parts.

Process redesign: redesign the process to exclude the required equipment.

Abandoning project/s: this involves cancelling and avoiding projects requiring the machinery, process and/or the outsourcing any of the parts.

Select alternative project: select an alternative project that doesn't require the equipment.

Leasing instead of purchasing: hiring or renting the equipment.

Resurrecting and overhauling: essentially fixing current equipment.

Purchase only: once-off payment to cover the full cost of the equipment.

Purchase on credit: pay for the equipment over a period of 3 or 5 years.

It is now necessary to elaborate on the mutual exclusivity and independence of the projects/alternatives. It has been stated previously that mutually exclusive projects are those that compete with one another. This means that the selections of one alternative will automatically mean the rejection of those other projects. Independent projects are projects where the selection of one alternative has no effect on the other decisions that must be made. Since each piece of equipment or process (excluding the stainless steel welding process) requires a large capital investment, it is apparent that K&M Signs would be better off not acquiring both digital and screen printers as they both fulfil a similar need. For this reason, the digital and screen printing projects are mutually exclusive as selection of one will mean the rejection of the other. All other projects are independent of one another.

Feasible solutions

Before the economic analysis is done, the number of alternatives can be reduced by selecting only the feasible solutions.

Redesigning the process to exclude the required equipment can be done with digital printing and screen printing by overlapping layers of vinyl to produce the same effect. This technique has replaced screen printing in many organisations in recent years. Digital printing however, provides the ability to produce higher complexity images in a

fraction of the time. K&M Signs overcomes the inability to weld stainless steel by either outsourcing the entire part or subassembly, or by producing the product using alternative materials and fastening techniques.

Abandoning projects to avoid purchasing machinery or outsourcing is not a viable alternative because many projects require these processes and provide a lot of revenue for K&M Signs. Likewise, the selection of alternative projects is not an option because the core activities of K&M Signs, as described in the mission statement, are to perform all necessary actions to produce and supply signage to the market.

Leasing the equipment also poses many problems because of the fact that the market for the equipment is limited, the type of equipment is very specific in some cases and it is expensive. Resurrecting and overhauling doesn't apply since K&M Signs has never had or used any of the equipment before. The equipment is also too expensive to purchase without making use of a loan.

Economic analysis

Table 7 provides the feasible alternatives that have been analysed by finding and comparing the present values. As highlighted by the study, the best alternative, economically, is the alternative that includes purchasing a digital printer and a crane truck. The second best alternative includes implementing the stainless steel welding process as well.

Table 7: Economic alternatives

	Laser cutter	Digital printer	Screen printer	Crane truck	Welding	Total
Alt 1	Purchase(5yr)	Do nothing	Do nothing	Do nothing	Implement	R -377,310.30
Alt 2	Purchase(5yr)	Do nothing	Do nothing	Purchase(5yr)	Implement	R -334,428.85
Alt 3	Purchase(5yr)	Do nothing	Purchase(5yr)	Do nothing	Implement	R -895,744.23
Alt 4	Purchase(5yr)	Do nothing	Purchase(5yr)	Purchase(5yr)	Implement	R -852,862.78
Alt 5	Purchase(5yr)	Purchase(5yr)	Do nothing	Do nothing	Implement	R 481,907.29
Alt 6	Purchase(5yr)	Purchase(5yr)	Do nothing	Purchase(5yr)	Implement	R 524,788.74
Alt 7	Do nothing	Do nothing	Do nothing	Do nothing	Implement	R -7,000.00
Alt 8	Do nothing	Do nothing	Do nothing	Purchase(5yr)	Implement	R 35,881.45
Alt 9	Do nothing	Do nothing	Purchase(5yr)	Do nothing	Implement	R -525,433.93
Alt 10	Do nothing	Do nothing	Purchase(5yr)	Purchase(5yr)	Implement	R -482,552.48
Alt 11	Do nothing	Purchase(5yr)	Do nothing	Purchase(5yr)	Implement	R 895,099.03
Alt 12	Do nothing	Purchase(5yr)	Do nothing	Do nothing	Implement	R 852,217.58
Alt 13	Purchase(5yr)	Do nothing	Do nothing	Do nothing	Outsource	R -370,310.30
Alt 14	Purchase(5yr)	Do nothing	Do nothing	Purchase(5yr)	Outsource	R -327,428.85
Alt 15	Purchase(5yr)	Do nothing	Purchase(5yr)	Do nothing	Outsource	R -888,744.23
Alt 16	Purchase(5yr)	Do nothing	Purchase(5yr)	Purchase(5yr)	Outsource	R -845,862.78
Alt 17	Purchase(5yr)	Purchase(5yr)	Do nothing	Do nothing	Outsource	R 488,907.29
Alt 18	Purchase(5yr)	Purchase(5yr)	Do nothing	Purchase(5yr)	Outsource	R 531,788.74
Alt 19	Do nothing	Do nothing	Do nothing	Do nothing	Outsource	R 0.00
Alt 20	Do nothing	Do nothing	Do nothing	Purchase(5yr)	Outsource	R 42,881.45
Alt 21	Do nothing	Do nothing	Purchase(5yr)	Do nothing	Outsource	R -518,433.93
Alt 22	Do nothing	Do nothing	Purchase(5yr)	Purchase(5yr)	Outsource	R -475,552.48
Alt 23	Do nothing	Purchase(5yr)	Do nothing	Purchase(5yr)	Outsource	R 902,099.03
Alt 24	Do nothing	Purchase(5yr)	Do nothing	Do nothing	Outsource	R 859,217.58

The cash flow used in the calculations of the above net present values is provided in appendix 5 at the end of this document.

Feasible solutions

The information in tables 1, 2 and 3 provided the information required concerning current expenditure, while also providing vital performance parameters for the sourced equipment.

Alternatives

Prices for the equipment are estimated by consulting the various equipment suppliers and vendors, K&M Signs' suppliers and management and finding the equipment on the Internet. An average of the figures ascertained was then calculated. These figures can be found in the table provided in appendix 5. The screen printer price includes the screen printer, 25 screens and the exposure unit. The price for implementing the stainless steel welding process is the cost of training K&M Signs' head welder to weld stainless steel.

The training covers:

- control of heat input and the longer times required to obtain a uniform temperature
- chromium and austenitic grades of stainless steel
- low heat, adequate jigging and copper backing bars
- preserving the integrity of the passive film (corrosion resistant layer).

Maintenance

As previously mentioned in the literature review, the equipment will be maintained using a combination of total productive maintenance and scheduled maintenance. The scheduled maintenance consists of only the major services required for each piece of machinery (displayed in table 8).

Table 8: Service periods

Equipment	Laser cutter	Digital printer	Screen printer	Crane truck
Service Period (Yrs)	Every 3 years	Yearly	Every 2 years	Every 2 years

Employees trained to use the new equipment will be entrusted with the day to day maintenance of the equipment.

Cash flow

Calculations include dividing the average monthly quantities by the standard unit sizes, which provides the average number of units sold. Using the average number of units sold in conjunction with the average cost of each type of material (from costing sheets), the materials costs are found and subtracted from the outsourced expenditure. What this series of calculations does is identify the cost of the outsourcing that excludes materials costs. The spreadsheets that demonstrate the calculations can be found in appendix 6.

The cash flow of each investment is calculated from the information acquired in the alternatives spreadsheet. The Cash Flow spreadsheet consists of the following:

- Interest (Prime rate); which includes a 1.) Current rate and 2.) Recent rate.
- Yearly Payment for the chosen rates of 12% and 15%, calculated with the *payment* function in excel (**PMT**(**rate**,**nper**,**pv**,fv,type)).
- Yearly Savings which is the amount saved by avoiding outsourcing (calculated in the previous spreadsheet).
- Inflation (CPIX); which includes a 3.) High and 4.) Low inflation rate.
- Maintenance, which includes Major Service frequencies and estimated costs.
- Finally, the Present Worth of the four possible combinations of selected rates are calculated. These calculations use the *present value* function (**PV**(**rate**,**nper**,**pmt**,fv,type)).

  The combinations of a prime lending rate of 15% and an inflation rate of 10% have been chosen for the continuing calculations.

Best alternative

To determine the best alternative, the alternatives have been listed and displayed with their corresponding net present worth (as displayed in Table 7). These values are calculated by adding the present values of each of the procurement options.

7.2 Justification

7.2.1 Procurement

The lead times of the outsourced parts, material and equipment can be significantly reduced by purchasing the required equipment. It is, however, obvious that this improvement alone doesn't justify the costs. The purchase of the crane truck should improve the time a customer waits for a large installation, by up to a day. The digital printer should improve lead times of digital prints by anything from a few hours to a day or two, depending on the size of the job. Stainless steel welding done in-house will also improve lead times of certain projects.

7.2.2 Economic analysis

The economic study was prepared by analysing cash flows over a period of ten years and took into account the cost of financing the equipment over 5 years, the savings due to reduced outsourcing and maintenance costs over the 10 year period. It shows a significant saving.

The new equipment will provide new competencies for K&M Signs with little disadvantages. It is recommended that these purchases be made.

7.3 Facilities planning

7.3.1 Product grouping

Core activities

Core activities identified in the mission statement, memorandum and articles of association indicate that K&M Signs' objective is to produce to order any signs required by its customers, where the term "sign" refers to a structure or posted notice bearing lettering or symbols. This includes both once-off and contract customers and also incorporates the maintenance and design of these signs.

Core competencies

Core competencies tie in closely with the versatility of a company. A company that monitors its competencies is usually versatile and has the ability to do many things well. K&M Signs' primary and supporting activities give the company the ability to perform the actions required of them, however, these actions are not always performed in the most timely and cost effective manner.

Value chain

The value chain is a model that illustrates a series of value-adding activities connecting a company's supply of raw materials, inbound logistics and production processes with its demand of outbound logistics, marketing, and sales (Rayport & Sviokla, 1996).

7.3.2 Product families

The job-shop environment of the signage industry implies that products of almost any size, shape and composition are produced. There is also no standard terminology for the industry. This means that the number of signs and terms describing them is vast and ambiguous. Furthermore, these terms are cumbersome and do not always describe the parts correctly; some of these are listed in the figure below.

Figure 3: Produce names

• Channel letters (no backing)	• Projecting Signs
• Channel letters (backing)	• Electronic Message Centres
• Dimensional letters	• Awning Signs
• Faces	• Magnetic
• Panels	• Construction Signs
• Non-illuminated Fascia	• Real Estate Signs
• Illuminated Fascia	• Formed Letters
• Illuminated sign section light box	• Parking Signs
• Vehicle Lettering	• Sandblasted Signs
• Wall Signs	• Carved Wood Signs
• Free-standing Pylon Signs	• Office Signs
• Channel letters	• Trade Show Signs
• Dimensional Letters	• Banners
• Free-standing Signs	• Yard Signs
• Wood Base/Architectural Signs	• Banners

The number of these terms needs to be reduced if the product families are to be valuable for the purpose of analysis. Grouping products according to some shared attributes will help when tracking the products progression through the factory.

Attributes that many of the products have in common are:

- electrical installations
- background lit
- neon lighting
- wooden components
- vinyl components
- Perspex™, PVC and/or other plastic components
- router/laser cut lettering
- painted parts
- metal frame or sub-frame

Products that require a large portion of time, management and planning on K&M Signs' behalf are usually the bigger projects and contract work. These are the products that require adequate material flow. A lot of business usually comes from petro-chemical companies which require refurbishment of entire filling stations, including pylons, pumps,

the canopy and the main overhead panel sign. Franchises often require many new main panel signs when they remarket there stores and casinos often require large amounts of neon signs. The typical products include:

- pylon signs
- neon and neon backed signs
- moulded Perspex™ signs
- formed sheet metal signs

7.3.3 Manufacturing cells

The manufacturing cells currently used and the space utilised can be seen in the current layout diagram (figures 1 & 2). These manufacturing cells include:

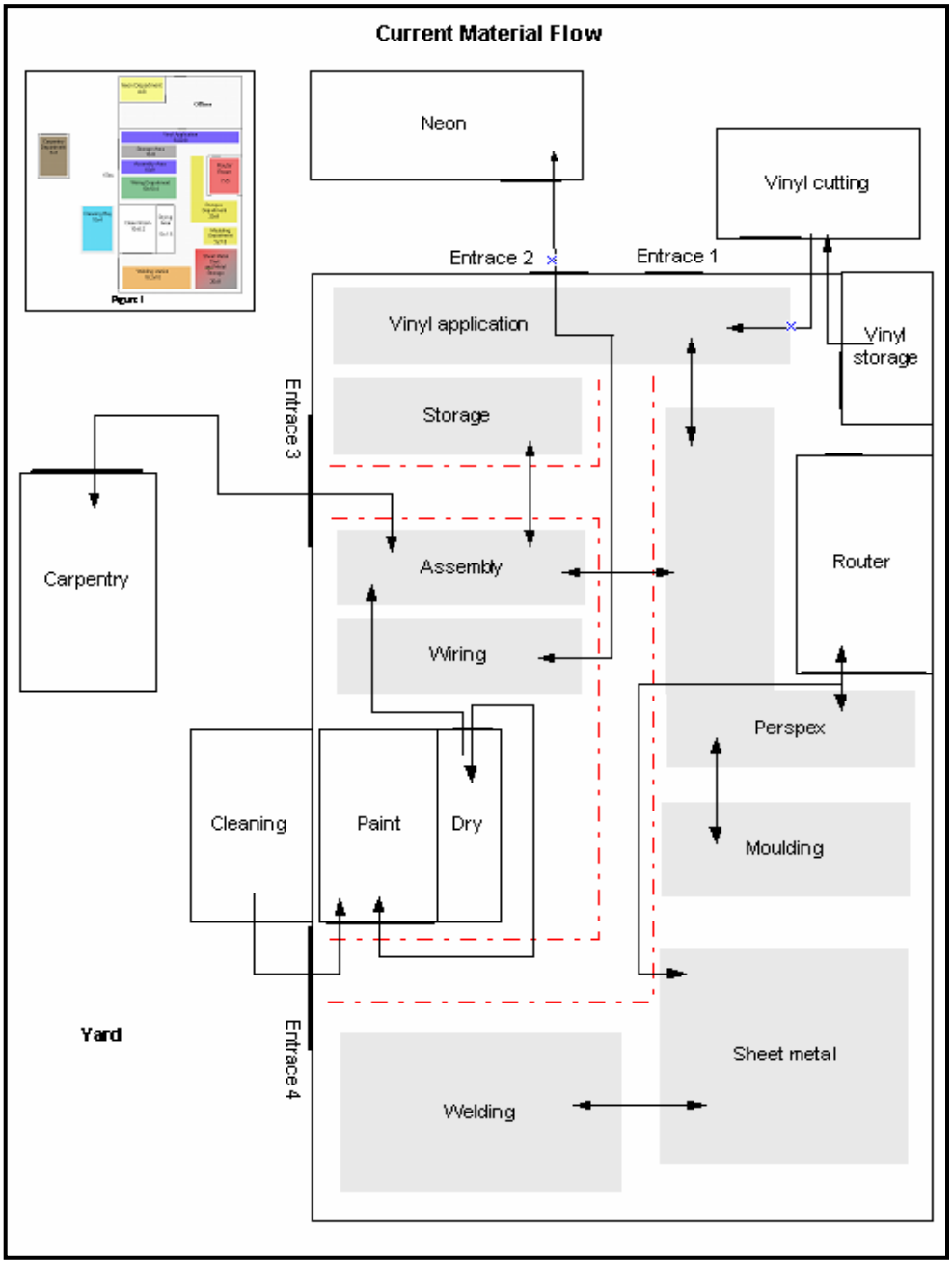
- Neon department
- Router room
- Clean rooms including paint and drying areas
- Vinyl cutting, storage and application departments
- Wiring department
- Sheet metal
- Perspex department
- Assembly area
- Welding station
- Storage area
- Moulding department
- Cleaning bay
- Carpentry

The addition to the manufacturing cells will include an area set aside for the digital printer.

Flow between manufacturing cells

Flow and space requirements are determined by lot sizes, storage systems, equipment type and the layout arrangements. The current facility layout shows a lack of material flow planning.

Figure 4: Current flow pattern



7.3.4 Facility requirements

Spatial requirements

The current space requirements of the respective manufacturing cells are provided in the table below. Additionally, the space required for the digital printer has been included and the welding station space has been amended.

Table 9: Spatial Requirements

Department	Current Area (m^2)	Other Requirement
Digital printer	8.8	Min. 2x2m
Vinyl application	104.0	-
Router room	35.0	Min. 6x4m
Perspex department	180.0	-
Sheet metal	180.0	Min. 15m length
Clean room (Paint)	52.0	Fixed area & position
Clean room (Drying)	15.0	Fixed area & position
Wiring department	104.0	Min. 10m length
Moulding department	39.0	-
Assembly area	90.0	-
Welding station	182.0	-
Storage area	90.0	-
Total floor space	**1079.8**	
Total available	**1352.0**	
Current aisle space	272.3	Estimate
Neon department	32.0	Fixed area & position
Vinyl cutting	19.1	Fixed area
Vinyl storage	7.7	Fixed area & position
Cleaning bay	40.0	Fixed area & position
Carpentry	15.0	Fixed area
Total	**1465.8**	

Floor loading

Floor loading capacities can often be cause for serious concern, as heavy equipment cannot be placed on a floor that is not strong enough without the floor being

strengthened. K&M Signs' facility has a uniform floor loading capacity throughout the factory and it is sufficient for all machinery.

7.3.5 "From-To" chart

The "From-To" chart sums up travel distances and presents flow data in a readily available format. The items moving between departments vary in size, weight, shape and threat of damage. For this reason, an acceptable measure of flow must be established. The selected method uses a combination of approximate distance travelled and estimated rate of recurrence.

Figure 5: From-To Chart

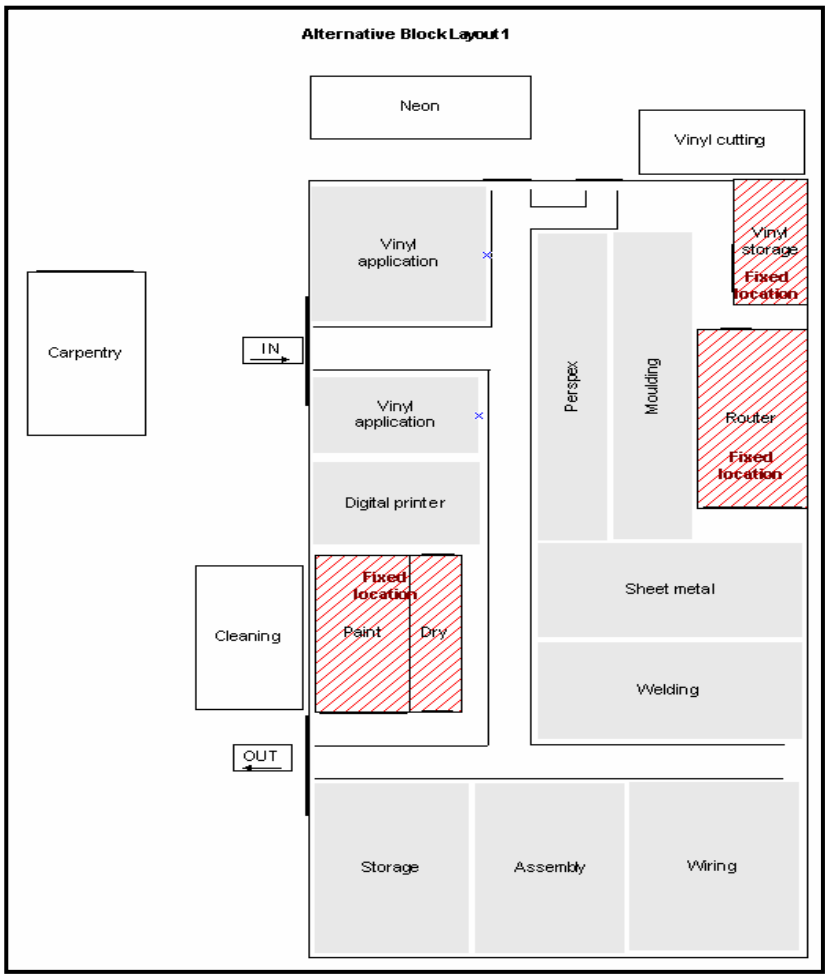
	Office	Vinyl application	Router room	Perspex dept	Sheet metal	Paint area	Drying area	Wiring dept	Moulding dept	Assembly area	Welding station	Storage area	Neon dept	Vinyl cutting	Vinyl storage	Cleaning bay	Carpentry
Office		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Vinyl application						45 4				10 2		5 4			8 1	50 1	45 1
Router room		10 4		5 10	30 3	45 3		15 1	10 2	15 2						55 1	50 1
Perspex department		10 6				30 5		10 7	5 1	10 7						55 1	
Sheet metal		45 1				25 5		35 1	5 1	40 5	5 2					30 1	
Clean room(Paint)		50 1					15 10										
Clean room (Drying)		30 1				15 4		5 2		10 5		20 5				30 1	
Wiring department				10 1						5 8		15 8					
Moulding department		35 4		5 3		15 4		25 2		15 3		20 1				35 1	50 1
Assembly area		10 3				30 4		5 5				5 10				30 1	
Welding station				30 5	5 5	10 4				35 2						30 1	60 1
Storage area	25 1	5 1	10 8	10 5					30 5								45 1
Neon department				15 6				15 10									
Vinyl cutting		10 10				20 3									5 4		45 1
Vinyl storage		8 5												5 10			
Cleaning bay		50 2	55 2	55 2	25 2	15 3			55 2			40 2					
Carpentry		45 3		50 3		55 2		45 1		50 2		50 1					

Distance Rate of recurrence (Scale 1 to 10)

The “From-To” chart provides three important pieces of information. It indicates what distances are travelled, how often these trips are made and also provides insight into the interrelationships of the manufacturing cells.

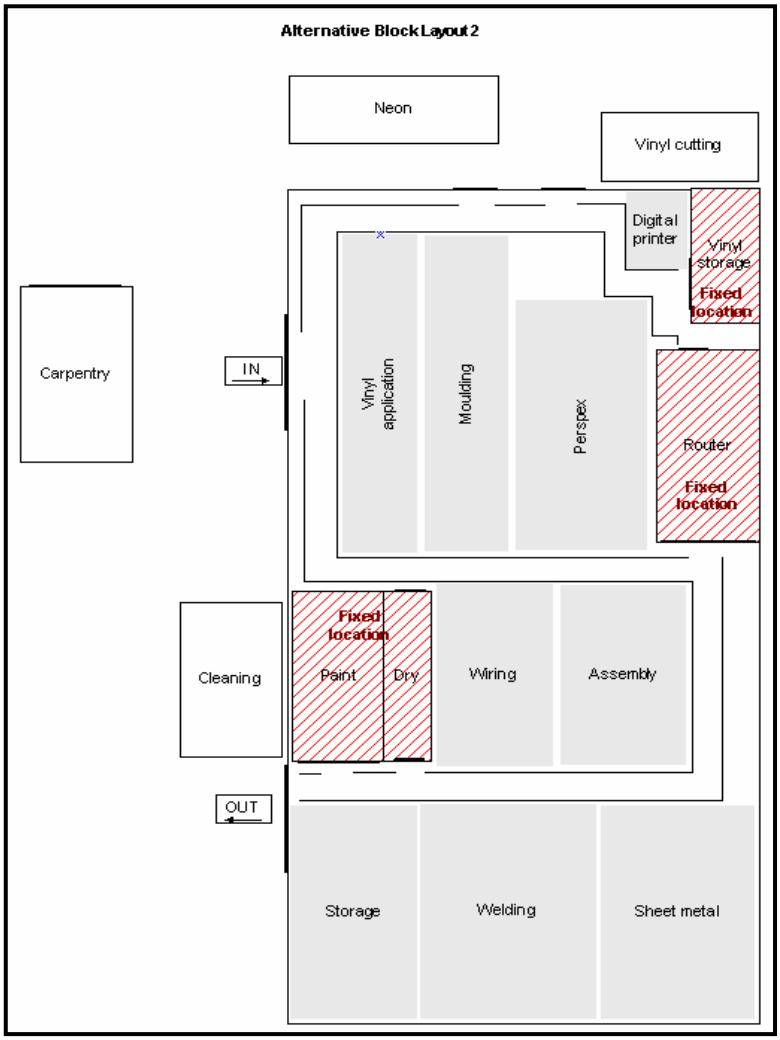
7.3.6 Alternative layout designs

Figure 6a: Alternative block layout 1



Alternative 1 groups similar activities while attempting to ensure straight line material flow through the factory and minimum flow in the opposite direction. The advantages are that heavy parts are close to the assembly cell, storage and the exit. And all manufacturing cells that require parts from the router are close by. The disadvantages are that many cells are far away from the assembly cell, the vinyl application cell is split up and a serious concern is that some assembled products may require vinyl application only after assembly is complete.

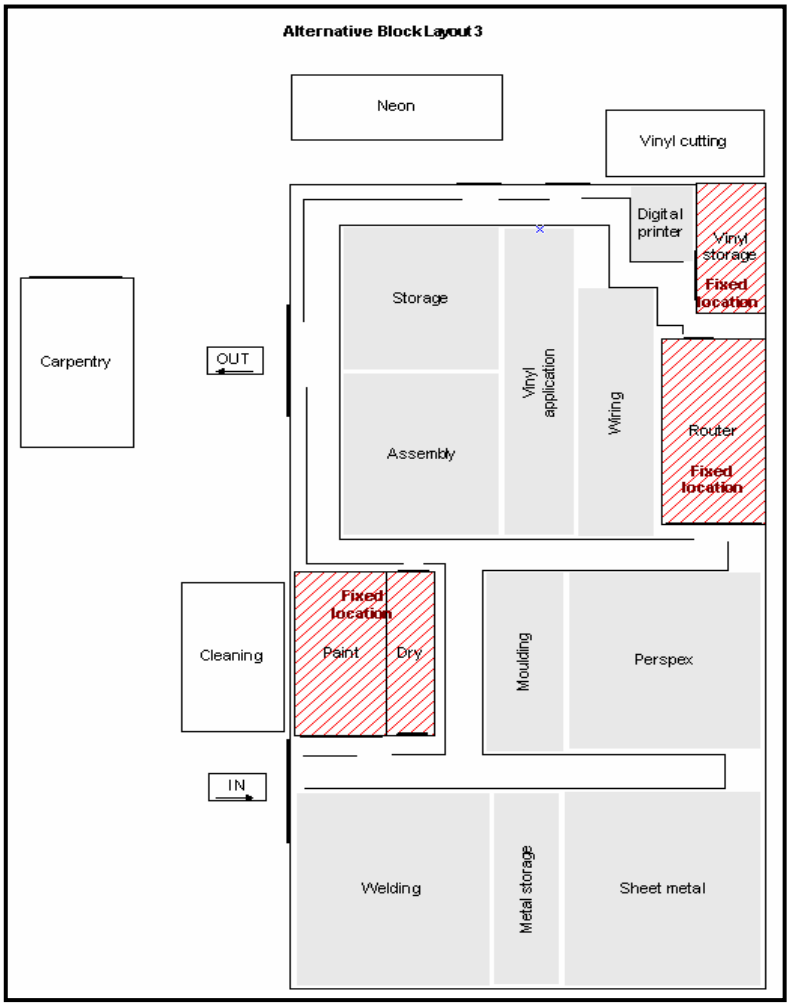
Figure 6b: Alternative block layout 2



Alternative 2 exhibits s-shaped flow characteristics and tries to keep the assembly cell in a central position while making sure heavy parts are out the way and near the exit. This layout also groups the necessary cells around the router. The problem with this layout is that the excessive aisle lengths translate into wasted space and plastic parts may require time in the clean room for dying, and must then be returned to the Perspex™ cell. The neon department is relatively far away from the wiring cell, as is the case with the first alternative. The advantages are better material flow and cell grouping.

Alternative 3 explores the possibility of reversing the material flow and includes an additional metal storage cell to reduce clutter and reduce the poor effect of the storage area being placed far from the heavy parts.

Figure 6c: Alternative block layout 3



The advantages of this layout include good access to all cells, an assembly cell that is close to the carpentry and neon cells, a wiring cell relatively close to the neon cell and good space distribution between large manufacturing cells. It must be noted that all alternatives depict a drying area with an additional entrance on the same side as the paint room entrance.

7.4 Ranking alternatives

The alternatives are graded according to the following criteria:

- aisle space
- material flow
- proximity of similar manufacturing cells to one another
- manufacturing cells planned size conformance with required size
- provision for large parts/products.

7.4.1 Space utilisation

Aisle space

The original layout of the factory consists of 85m of aisles and a total aisle area of 1.25m^2. This is deceiving, as it is less than any of the alternatives developed. The reason for this is due to very narrow aisles that don't lead to all the manufacturing cells.

Alternative 1 provides the lowest aisle space requirements, and is therefore the best choice in this respect.

Table 10:

Estimated Aisle Characteristics			
	Length (m)	**Width (m)**	**Area (m^2)**
Original	85.00	1.50	127.50
Alternative 1	87.80	1.75	153.65
Alternative 2	105.00	1.75	183.75
Alternative 3	105.00	1.75	183.75

7.4.2 Materials handling

Material flow

An Activity Relationship Chart has been developed from the "From-To" chart and assigns the value of 1, 2, 3 or 4 for each relationship. These values represent very

important, important, average or unimportant relationships respectively. The relationships are assigned in the following way:

Very important: When there is material/parts flow between the two departments; in both directions.

Important: When there is high material/parts flow between the two departments in only one direction.

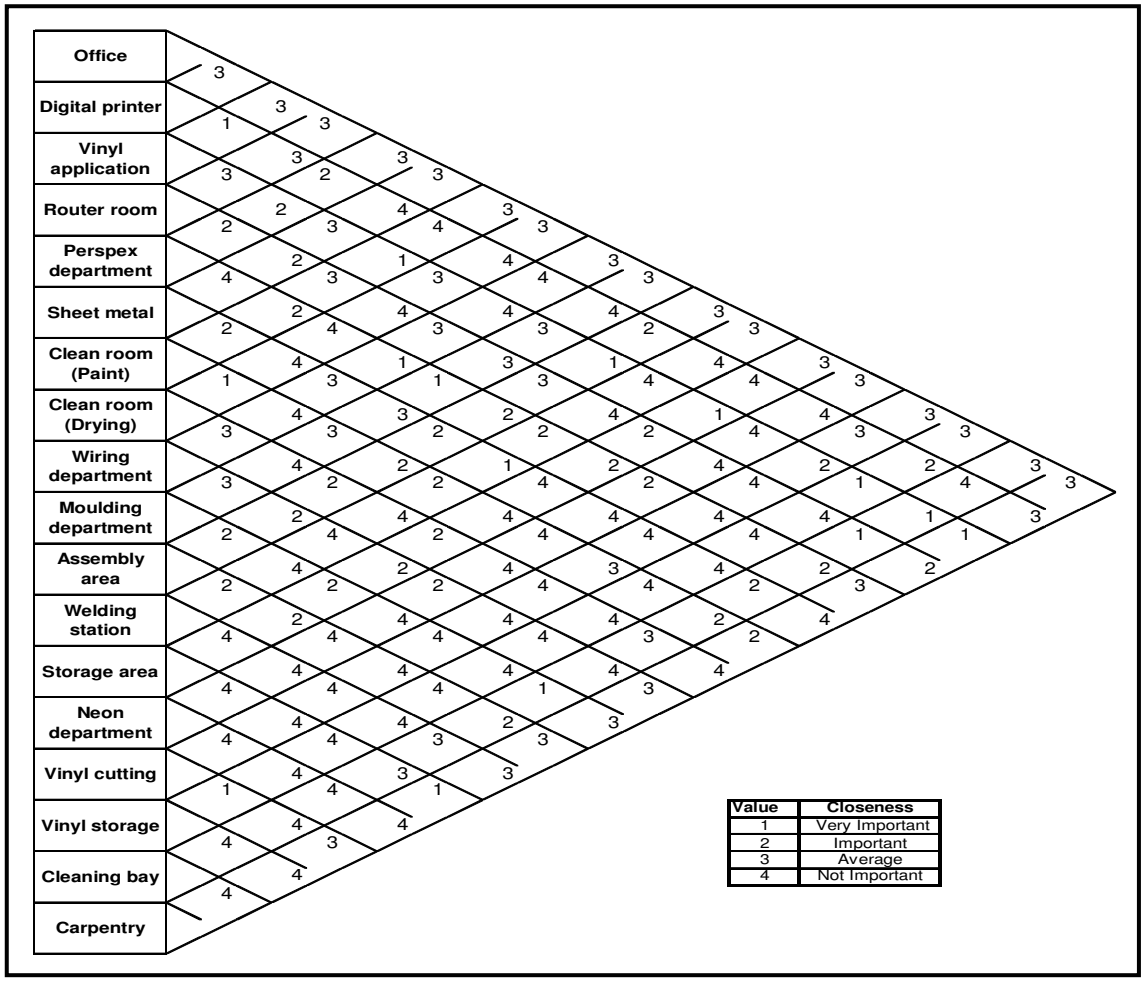
Average: When there is medium material/parts flow between the two departments.

Not important: When there is little or no material/parts flow between the two departments; in both directions.

The Activity Relationship Chart indicates that the most important relationships are the ones between:

- the Vinyl Application and the Painting, Digital Printing, assembly area, storage area, vinyl storage, cleaning bay and the Carpentry Departments
- the router room and the cleaning bay
- the Perspex™ Department and both the Wiring and Moulding Departments
- the Sheet Metal and Welding Departments
- the painting and drying areas
- the Moulding Department and the cleaning bay
- the Vinyl Cutting and Vinyl Storage Departments
- the storage area and Carpentry Department

Figure 7: Activity Relationship Chart



The relationships involved with vinyl application consist of two types of material flow. The first is the flow of the vinyl and the second is the flow of the parts. Only the flow of parts should affect the layout as the parts are heavy and are not moved as easily as the vinyl. The relationship between the vinyl cutting and vinyl storage areas also need not be considered.

7.4.3 Size and dimensions

The following table examines the distances between the manufacturing cells in the various alternatives.

Table 11: Proximity Analysis

Relationship	Department A	Department B
1	Vinyl Appl.	Paint
2	Vinyl Appl.	Assembly
3	Vinyl Appl.	Storage
4	Vinyl Appl.	Cleaning Bay
5	Vinyl Appl.	Carpentry
6	Router	Cleaning Bay
7	Perspex	Wiring
8	Perspex	Moulding
9	Sheet Metal	Welding
10	Painting	Drying
11	Moulding	Cleaning Bay
12	Storage	Carpentry

Proximity Rating				
Relationship	Original	Alternative 1	Alternative 2	Alternative 3
1	5	4	3	2
2	2	4	2	1
3	1	5	5	1
4	5	4	4	5
5	5	4	4	5
6	-	-	-	-
7	1	4	1	1
8	1	1	1	1
9	1	1	1	2
10	3	1	1	1
11	3	5	4	2
12	2	4	4	2
Total	29	37	30	23
Legend	1	Excelent	4	Poor
	2	Good	5	Very Poor
	3	Average		

It is apparent, from the table, that Alternative 3 has the best layout in terms of proximity and material flow. Alternative 2 is second best, while Alternative 1 may cause some material handling problems.

The Work Principle is another way to evaluate material flow and uses the volume or weight of products multiply by the distance moved. This method of evaluation will be difficult to adapt to the job-shop background of K&M Signs because most of the projects are unique and the weight of the parts can only be estimated.

7.4.4 Department shapes

Smooth department borders and regular shaped departments are important, firstly to ensure that main aisles are as straight as possible, and therefore as short as possible and secondly, an irregularly shaped department makes planning that department's layout extremely complex (Tompkins et al., 2003).

Alternatives 2 and 3 are best in this respect because all departments are rectangular. Furthermore, in the original layout the Perspex™ department is an irregular shape and Alternative 1 splits the vinyl application department into two parts.

7.4.5 Manufacturing cells: planned size conformance with required size

It is imperative that the new layouts provide each department with at least the minimum required space. Table 11 provides current spatial conditions of each department, while the following table reviews the space provided for each department by each alternative.

Table 12: Space allocation

	Alternative 1			Alternative 2			Alternative 3		
	L (m)	W (m)	Area(m^2)	L (m)	W (m)	Area(m^2)	L (m)	W (m)	Area(m^2)
Digital printer	8	8	64	6	2.6	15.6	6	2.6	15.6
Vinyl application	8 and 14	8 and 8	176	24	4.5	108	24	4	96
Perspex department	24	6	144	20	7.2	144	16.5	10.5	173.25
Sheet metal	8	11	88	19	9	171	18.5	9.5	175.75
Wiring department	15	8	120	16	6.5	104	20	4	80
Moulding department	24	2	48	24	2	48	16.5	2.5	41.25
Assembly area	15	6	90	16	6.5	104	13	7	91
Welding station	8	11	88	19	8.3	157.7	18.5	9.5	175.75
Storage area	15	7	105	19	4.5	85.5	11	7	77
Additional storage							18.5	1.8	33.3
Total			923.0			937.8			958.9
Add: Other Dept's			102.0			102.0			102.0
Est. Aisle space			153			183			183
Total Space (1352m^2)			1178.0			1222.8			1243.9

It can be seen from Table 12 that the Sheet Metal Department in Alternative 1 doesn't have the required 15m length that is a required by that department. Alternative 1 also has welding, sheet metal and Perspex™ departments that are much smaller than the current layout. Alternative 2 has the same problem, although the differences are much smaller. Alternative 3 only falls short by less than 7m^2 in the sheet metal and welding stations, and is therefore the best alternative.

It is clear, from the layout analysis, that Alternative 3 is the alternative best suited to the needs of K&M Signs' and offers the most effective design and materials handling and flow advantages.

8. Recommendations

The study of the availability and feasibility of equipment procurement for K&M Signs yields the possibilities of improved profits. The study has shown that the procurement of a crane truck and digital printer would not only be economically beneficial but would provide equal benefit in the improvement that it would have on operations. It is therefore recommended that K&M Signs purchase a Crane truck and a Digital printer. Further more, additional training for the head welder is also recommended. This training will ensure that the person involved will have a complete range of welding skills and that time and money is not wasted outsourcing this task. For the wellbeing of the metal work processes, future training of additional welders will ensure that these processes are not dependent on an individual employee.

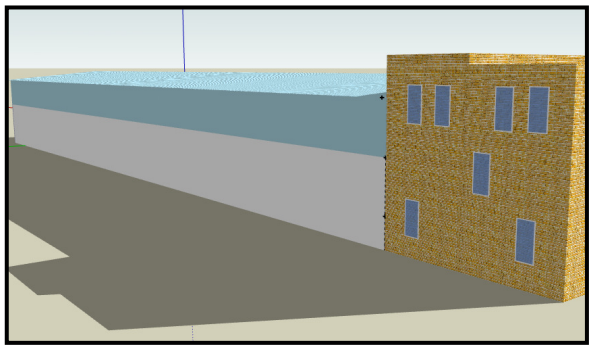
From a facilities layout and planning stand point, the study has identified a number of areas where there is great potential for improvement. Material flow can be improved by grouping similar manufacturing cells and decreasing distances between the more frequently travelled routes. Improved department shapes will have the effect of reducing damage to parts and products. It is recommended that the selected layout design is implemented as it will reduce clutter, work in progress and lead times. The new layout will also improve productivity and machine utilisation, while accommodating the purchase and implementation of a digital printer.

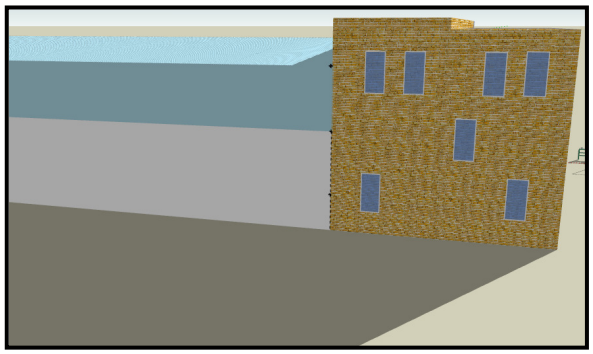
9. Conclusion

In light of the research and fact finding completed in resolving the problems of this project, it is evident that the techniques applied have assisted in identifying a most favourable solution including the implementation of any necessary change.

The application of the approach has assisted in the selection of the best procurement plan and associated facilities plan. Implementing the procurement measures proposed will improve efficiency, reduce costs and lead times and assist in the effective utilisation of the employees and machinery involved. The facilities plan takes into account all relevant details of the manufacturing cell environment and groups these cells, further reducing lead times, work in progress and clutter; while improving material flow and storage.

To summarise, the investment in a digital printer and crane truck are recommended. Additionally, an employee should be trained to weld stainless steel. These changes should be implemented with the new layout design and the correct maintenance plans. The changes will provide a basis for product expansion and improved operations, which aims at a more versatile business with well rounded competencies. It must however be borne in mind that improvement should be continuous and additions of a laser cutter and screen printing process may become viable at a later stage.





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11. Appendix

Appendix 1: Email (containing monthly expenditure)

Lemont

From: Bill Treki [billt@kmsigns.co.za]
Sent: 29/05./2008 5:38 PM
To: heath.rogers@telkomsa.net
Cc: heath@tuks.co.za
Subject: RE : K & M Signs / Research Project

Hello Heath,
Sorry about the delay.
Information requested :

Monthly spend :

1) crane hire : R 50 000.00
2) digital printing : R 20 000.00
3) laser cutting : R 1 000.00
4) screen printing : R 10 000.00

Crane hire in past years has been lower ie R 8 000.00 per month.The last year (2007) was distorted by long distance deliveries ie Namibia (x 2),Botswana (x 2),Zambia (x 2),Kzn (x 2) and Zim border (x 2).

Estimated in put costs :

Sreen printing R 250.00 m. sq. (full colour print on clear vinyl, roughly 50 % split),screen printing R 125.00 m. sq. (highly variable with volume).
A crane truck will cost about R 3 500.00 per day to hire locally and the travel rate was about R 11.00 / km (ie 7.0 m bed length with crane able to lift 1.5 t at hook height of 9.5 m, etc).That figure is now probably R 16.00 / km.
The laser cutting is so low because we have not in the past done much and the bulk of the work has not been captured by Donovan's stats (ie current and not invoiced).

Bill

30/05/2008

NON ILLUM FASCIA COSTING 2007/1/26

	Brandon		ESTIMATING COST SHEET						
DATE									
CLIENT									
LOCATION									
SP									
EST	NON ILLUM FASCIA								
DESCRIPTION /SPEC									
DATE PRICED 12/01/2007									
QTY									
MAT.DESCRIPTION		QTY	COST	TOTAL COST	LABOUR	HR	RATE	COST	
TUBE	25 X 25 X1.6 MM MILD - STEEL 1.2kg/m		14.86	0.00	S/CHECK		100.00	0.00	
TUBE				0.00	WELD		100.00	0.00	
TUBE	25 X 25 X1.5 MM ALI		14.76	0.00	S/METAL		100.00	0.00	
ANGLE	38 X 1.6 MM		25.88	0.00	PX / FAB		100.00	0.00	
BASE-PLATES				0.00	PX / CUT		100.00	0.00	
PINS	BRASS		2.00	0.00	PPX/ASSM		100.00	0.00	
TAPE	DOUBLE SIDED TAPE PER M		8.00	0.00	GRAPHIC		100.00	0.00	
CHROMADEK	0.8 mm		72.00	0.00	MOULD		100.00	0.00	
BEADING	MED " H " PER M		15.00	0.00	NEON		100.00	0.00	
BEADING	BIG " H " PER M		23.00	0.00	N/WIRE		100.00	0.00	
PPX	3 MM COLOUR		219.00	0.00	ADV.600		100.00	0.00	
PPX	3 MM OPEL		198.00	0.00	ASSEMBLY		100.00	0.00	
PPX	5 MM OPEL		275.00	0.00	PAINT		100.00	0.00	
PPX	3 MM CLR		170.00	0.00	FLO.WIRE		100.00	0.00	
PPX	5 MM CLR		262.00	0.00	WOODWORK		100.00	0.00	
SIGN SECTION	150 MM PER M		60.00	0.00	VINYL APPL		100.00	0.00	
ALI.SHEET	2 MM		186.00	0.00			100.00	0.00	
ALI.SHEET	1.6 MM		149.00	0.00	ARTWORK		100.00	0.00	
SPIRITFLEX	EXTRUSION + INSERT COMPLETE PER M		38.67	0.00	TOTAL LABOUR			0.00	
DIGITAL PRINT	FOOTPRINT ON VINYL		195.00	0.00					
DIGITAL PRINT	FOOTPRINT ON PVC		175.00	0.00					
PAINT	COLOUR		167.00	0.00	ADDITIONAL EXPENSE				
PAINT	WHT OR BLK		50.00	0.00		UNIT	RATE	COST	
VINYL	COLOUR 1220 MM		90.00	0.00	TRAVEL/KM		2.50	0.00	
VINYL	COLOUR 610 MM		45.00	0.00	TRAVEL/HR		200.00	0.00	
VINYL	BLK & WHT 1220 MM		50.00	0.00	TRANSPORT			0.00	
VINYL	BLK & WHT 610 MM		30.00	0.00	ACC		900.00	0.00	
VINYL	SANDBLASTED 1220 MM		93.00	0.00	RIGGING		200.00	0.00	
FLO.TUBES				0.00	LOADING		200.00	0.00	
FLO.TUBES				0.00	OFF-LOADING		200.00	0.00	
FLO.TUBES				0.00					
BALLASTS				0.00	TOTAL			0.00	
STARTERS+HOLDERS				0.00					
FLO.TUBES				0.00					
FLO.TUBES				0.00					
BALLASTS				0.00	COST				
				0.00					
MATERIAL COSTS				0.00	MATERIAL			0.00	
			CONSUMABLES	0.00	LABOUR			0.00	
			TOTAL MATERIAL COSTS	0.00	OUTWORKS			0.00	
					ADDITIONAL			0.00	
OUTWORK/COST									
MAT.DESCRIPTION		QTY	COST	TOTAL COST	TOTAL COST			0.00	
	GALV		5.50	0.00					
				0.00					
				0.00					
				0.00	SELLING				
				0.00					
				0.00	MATERIAL			0.00	
				0.00	LABOUR			0.00	
				0.00	OUTWORKS			0.00	
				0.00	ADDITIONAL			0.00	
				0.00					
			TOTAL	0.00					
			SP/%	#DIV/0!	TOTAL	SELL		0.00	

	Brandon		ESTIMATING COST SHEET						
DATE									
CLIENT									
LOCATION									
SP									
EST	ILLUM SIGN SECTION LIGHTBOX								
DESCRIPTION /SPEC									
DATE PRICED 10/01/2007									
QTY	1								
MAT.DESCRIPTION		QTY	COST	TOTAL COST	LABOUR	HR	RATE	COST	
ANGLE	25 X 25 X1.6 MM MILD - STEEL 1.2kg/m		14.86	0.00	S/CHECK		100.00	0.00	
TUBE	25 X 25 X1.5 MM ALI		14.76	0.00	WELD		100.00	0.00	
TUBE				0.00	S/METAL		100.00	0.00	
TUBE	50 X 50 X 2 MM ALI		42.72	0.00	PX / FAB		100.00	0.00	
ANGLE	30 X 3 MM MILD STEEL		11.00	0.00	PX / CUT		100.00	0.00	
BASE-PLATES	50 X 6 MM MILD - STEEL		16.84	0.00	PPX/ASSM		100.00	0.00	
SPIRITFLEX	EXTRUSION + INSERT COMPLETE PER M		38.67	0.00	GRAPHIC		100.00	0.00	
CHROMADEK	0.8 mm		72.00	0.00	MOULD		100.00	0.00	
BEADING	MED " H " PER M		15.00	0.00	NEON		100.00	0.00	
BEADING	BIG " H " PER M		23.00	0.00	N/WIRE		100.00	0.00	
KOMAPLUS / SIGN - X	10 MM		236.20	0.00	ADV.600		100.00	0.00	
PPX	3 MM OPEL		188.00	0.00	ASSEMBLY		100.00	0.00	
PPX	5 MM OPEL		275.00	0.00	PAINT		100.00	0.00	
PPX	3 MM PRISMATIC		109.00	0.00	FLO.WIRE		100.00	0.00	
PPX	5 MM CLR		261.00	0.00	WOODWORK		100.00	0.00	
SIGN SECTION	150 MM PER M		61.48	0.00	VINYL APPL		100.00	0.00	
ALI.SHEET	2 MM		186.00	0.00			100.00	0.00	
ALI.SHEET	1.6 MM		149.00	0.00	ARTWORK		100.00	0.00	
SPIRITFLEX	EXTRUSION + INSERT COMPLETE PER M		38.67	0.00	TOTAL LABOUR			0.00	
DIGITAL PRINT	FOOTPRINT ON VINYL		195.00	0.00					
DIGITAL PRINT	FOOTPRINT ON PVC		175.00	0.00					
PAINT	COLOUR		80.00	0.00	ADDITIONAL EXPENSE				
PAINT	WHT OR BLK		50.00	0.00		UNIT	RATE	COST	
VINYL	COLOUR 1220 MM TRANSLUCENT		90.00	0.00	TRAVEL/KM		2.50	0.00	
VINYL	COLOUR 610 MM TRANSLUCENT		45.00	0.00	TRAVEL/HR		200.00	0.00	
VINYL	BLK & WHT 1220 MM		50.00	0.00	TRANSPORT			0.00	
VINYL	BLK & WHT 610 MM		30.00	0.00	ACC		900.00	0.00	
FLO.TUBES	5FT TUBE + BALLAST + STARTER + HOLD		48.85	0.00	RIGGING		200.00	0.00	
FLO.TUBES	4FT TUBE + BALLAST + STARTER + HOLD		33.75	0.00	LOADING		200.00	0.00	
FLO.TUBES	3FT TUBE + BALLAST + STARTER + HOLD		40.75	0.00	OFF-LOADING		200.00	0.00	
FLO.TUBES	2FT TUBE + BALLAST + STARTER + HOLD		33.75	0.00					
BALLASTS	18" TUBE + BALLAST + STARTER + HOLD		33.75	0.00	TOTAL			0.00	
STARTERS+HOLDERS			6.75	0.00					
FLO.TUBES	2 X 8FT + BALLAST		191.00	0.00					
FLO.TUBES	2 X 6FT + BALLAST		205.00	0.00					
BALLASTS				0.00	COST				
				0.00					
MATERIAL COSTS				0.00	MATERIAL			0.00	
			CONSUMABLES	0.00	LABOUR			0.00	
		TOTAL MATERIAL COSTS		0.00	OUTWORKS			0.00	
					ADDITIONAL			0.00	
OUTWORK/COST									
MAT.DESCRIPTION		QTY	COST	TOTAL COST	TOTAL COST			0.00	
				0.00					
				0.00					
				0.00					
				0.00	SELLING				
				0.00					
				0.00	MATERIAL			0.00	
				0.00	LABOUR			0.00	
				0.00	OUTWORKS			0.00	
				0.00	ADDITIONAL			0.00	
				0.00					
			TOTAL	0.00					
			SP/%	#DIV/0!	TOTAL	SELL		0.00	

ESTIMATING COST SHEET

DATE	
CLIENT	
LOCATION	
SP	
EST	
DESCRIPTION /SPEC	
Quantities/1-OFF	

Material Category	Material Description	Size			Details	Unit	Qty	Rates	Total Cost
Material Costs							Sub Total		R 0.00
							Consumables		R 0.00
						Total Material Costs			R 0.00

OUTSOURCE COMPONENTS									
						Total Outsource Comp.			R 0.00

SPECIALIZED RIGGING EQUIPMENT									
Category	Material Description	Size			Details	Unit	Qty	Rate	Total Cost
SPECIALIZED TRANSPORT									
									R 0.00
CRAINAGE									
									R 0.00
SCAFFOLDING									
									R 0.00
								Total	R 0.00
								SP%	#DIV/0!

FACTORY LABOUR	HR		RATE	COST
COMPUTER EDITING	ALL		R 100.00	R 0.00
ROUTER	CUT		R 100.00	R 0.00
CARPENTRY MOULDS	WOOD		R 100.00	R 0.00
CARPENTRY GENERAL	WOOD		R 100.00	R 0.00
PPX/FAB	P.MNF		R 100.00	R 0.00
PERSPEX MOULDING	P.MNF		R 100.00	R 0.00
BRUSHING/CLEANING	P.MNF		R 100.00	R 0.00
VINYL (CUT/WEED/APPLIC TAPE)	MNF		R 100.00	R 0.00
PPX/VINYL ASSEMBLY	P.MNF		R 100.00	R 0.00
STRUCTURAL STEEL	MNF		R 100.00	R 0.00
S/METAL (BOXES/LETTERS/CLAD')BEAD	MNF		R 100.00	R 0.00
ALUMINUIM FAB	MNF		R 100.00	R 0.00
ALUMINUIM WELD	MNF		R 100.00	R 0.00
NEON	MNF		R 100.00	R 0.00
PAINT	PNT		R 100.00	R 0.00
NEON WIRING	WIRE		R 100.00	R 0.00
FLO. WIRING	WIRE		R 100.00	R 0.00
ASSEMBLY	MNF		R 100.00	R 0.00
TOTAL LABOUR				R 0.00

RIGGING EXPENSES				
DESCRIPTION	HRS/KMS/DAYS		RATE	TOTAL
SITE CHECK ONLY (ON SITE)	Hours		R 200.00	R 0.00
LOADING	Hours		R 200.00	R 0.00
OFF-LOADING	Hours		R 200.00	R 0.00
INSTALLATION (ON SITE)	Hours		R 200.00	R 0.00
DELIVERY ONLY (ON SITE)	Hours		R 200.00	R 0.00
TRAVEL//	Kilo		R 2.50	R 0.00
TRAVEL	Hours		R 200.00	R 0.00
ACCOMMODATION	Day (s)		R 900.00	R 0.00
LOCAL TRAVEL	Day (s)		R 200.00	R 0.00
BORDER CROSSING (S)	Hours		R 200.00	R 0.00
OTHER				R 0.00
TOTAL				R 0.00

COST	
MATERIAL	R 0.00
OUTSOURCE COMPONENTS	R 0.00
SPECIALIZED RIGGING EQUIPMENT	R 0.00
FACTORY LABOUR	R 0.00
RIGGING EXPENCES	R 0.00
TOTAL	R 0.00

SELLING	
MATERIAL	R 0.00
OUTSOURCE COMPONENTS	R 0.00
SPECIALIZED RIGGING EQUIPMENT	R 0.00
FACTORY LABOUR	R 0.00
RIGGING EXPENCES	R 0.00
TOTAL R 0.00 SELL	R 0.00

Appendix 3: Supplier Charges

Faxed information including:

- Crane truck quotations
- Laser cutting price lists
- Other estimates

Crane truck quotations

2008 May 30 14:24 K&M Signs Natal 031 7005902 p.3

Nbaum Bord Verkuif.

(1)

C.A. WOLFAARDT CC

17 Stephenson Street

Industrial Sites, Newcastle

MOBILE CRANE HIRE • FORKLIFTING • SANDBLASTING
MOBIELE HYSKRANE • PUSHKYSERS • SAND STRAALING

Tel 034 3757453
Fax 034 3764352

Mortimer Toyotha - Newcastle

P O Box 742
NEWCASTLE 2940

QUOTATION

DATE : 17-04-2008 FIRM : K&M Signs - Durban

FAX : 031-7005902 TEL : 7005883

ATT : Brandon CELL : .....

SITE ESTABLISHMENT TO Toyotha Newcastle.

CRANE CAPACITY : 30 TON

MINIMUM 6 HOURS @ R 500-00 = R 3000-00

+ 20 % INSURANCE ON CRANE ONLY = R 600-00

RIGGER & EQUIPMENT :

MINIMUM ..... HOURS @ R ..... = R .....

8 TUN TRUCK :

MINIMUM ..... HOURS @ R ..... = R .....

FORKLIFT CAPACITY : ..... TON

MINIMUM ..... HOURS @ R ..... = R .....

= = = R 3600-00

+ 14 % V.A.T. @ R 504-00

TOTAL R 4104-00

FIRST NATIONAL BANK — NEWCASTLE

BRANCE CODE : 270 — 324

ACCOUNT : 5314 085 3657

DIREKTEURE - C.A. Wolfaardt - DIRECTORS

Crane HIRE TO MOVE ENGEN PRIME SIGN.

1

JOHNSON ACCESS (PTY) LTD

Reg. No.2002/007063/07

Physical Addresses:
- 13 Commercial Road, Wadeville, Germiston
- Unit 7A Metropolitan Park, Bevan Road, Roodekop Industrial, Germiston
- 60 Chamberlain Road, Jacobs, Durban

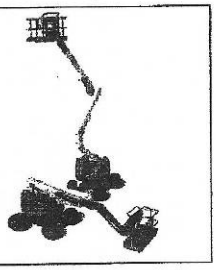
Postal Address:
- P O Box 14063, Wadeville 1422, Gauteng, South Africa

Electronic Mail:
info@johnsonaccess.co.za

Telephone Numbers:
- Telephone: (011) 902-7770 JHB
  Telefax: (011) 902-7769
- Telephone: (031) 468-1138 KZN
  Telefax: (086) 682 2859

Cellular Phone Numbers:
- Mobile JHB: 0829040744
- Mobile KZN: 0825655270
- Mobile PTA: 0828749059

Website:
www.johnsonaccess.co.za



TELEFAX TRANSMISSION

TO:	K & M SIGNS	FROM:	LINDA McLEOD
ATTENTION:	BRANDON	FAX NO:	086 682 2859
DATE:	26 MAY 2008	OUR REF:	JA/kzn/1411
E-MAIL:	Brandon@kmsigns.co.za	PAGES:	2. (Incl. this page)

If this transmission has not been received in a legible manner, please advise by telephoning: (+2731) 468-1138.

RE: HIRE OF ACCESS PLATFORM

Further to our discussion thank you for your valued enquiry regarding the hire of an access platform at **TUGELA PLAZA ONE STOP** and have pleasure in submitting our quotation as detailed hereunder. If you would like to have a look at the machines in our fleet, a full set of specifications can be viewed at www.johnsonaccess.co.za

Detail:

#	UNIT DESCRIPTION	DAILY HIRE RATE (1–4 Days)	WEEKLY HIRE RATE (1–4 Weeks)	MONTHLY HIRE RATE (1 Month +)	DAMAGE WAIVER COVER	SITE ESTABLISHMENT CHARGE* DELIVERY TO SITE	SITE ESTABLISHMENT CHARGE* COLLECTION FROM SITE
1.	Z45/25J RT Genie - Articulating Boom lift - 15.54 m Working height – Self Propelled – Diesel Note: Subject to availability	R 1 200.00 Per Day	R 5 250.00 Per Week	R 18 500.00 Per Month	6% of hire rate (See Overleaf)	R 2 500.00 PER TRIP	R 2 500.00 PER TRIP

NOTE: You may elect to collect and deliver the units to and from our premises yourself, in which case a site establishment charge will not be applicable.

This offer is based on and in strict accordance with the terms and conditions contained overleaf.

Thank you for contacting Johnson Access and giving us the opportunity to provide you with this quotation.

Yours faithfully
JOHNSON ACCESS (PTY) LTD

JOSE DE PAIVA
Branch Manager
082 565 5270

Customer to complete and return by fax to Johnson Access at telefax no. (086) 682 2859

Authorised by:..... Signature: ..... Order No. ..... Date:.....

Delivery date:..... Time:..... Remarks:.....

CHERRY PICKER / ART BOOM LIFT FOR SIGN INSTALLATION.

Laser cutting price lists

ALUMINIUM

HEIGHT	1,6 C	1.6 M	2.0 C	2.0 M	3.0 C	3.0 M
20	4.36	0.31	4.49	0.39	4.62	0.58
100	9.00	3.38	9.65	4.22	10.28	6.33
200	14.87	11.84	16.17	14.80	17.44	22.20
300	20.67	25.45	22.62	31.81	24.52	47.71
400	26.96	44.19	29.56	55.24	32.09	82.86
500	32.77	68.08	36.01	85.10	39.17	127.65
600	39.02	97.86	42.91	122.32	46.70	183.49
700	44.83	132.15	49.36	165.19	53.78	247.78
800	50.63	256.84	55.81	321.06	60.66	481.58
900	56.90	288.20	62.72	360.25	68.40	540.38
1000	62.70	364.36	69.17	455.45	75.48	683.18

BRASS

HEIGHT	1,6 C	1.6 M	2.0 C	2.0 M	3.0 C	3.0 M
20	4.98	2.18	5.30	2.72	5.56	4.08
100	12.01	23.85	13.60	29.81	14.85	44.71
200	20.90	83.59	24.08	104.49	26.59	156.74
300	29.70	179.63	34.44	224.53	38.20	336.80
400	39.00		45.32		50.33	
500	47.80		55.69		61.94	
600	57.04		66.50		74.00	
700	65.84		76.87		85.61	
800	74.63		87.24		97.22	
900	83.89		98.07		109.30	
1000	92.69		108.43		120.91	

MILD STEEL

HEIGHT	1.6 C	1.6 M	2.0 C	2.0 M	3.0 C	3.0 M	5.0 C	5.0 M	8.0 C	8.0 M
20	4.01	0.21	4.06	0.26	4.36	0.39	6.00	0.69	7.07	1.0967
100	7.33	2.30	7.58	2.87	9.00	4.31	13.49	7.51	18.68	12.012
200	11.52	8.05	12.03	10.06	14.87	15.09	22.95	26.32	33.35	42.106
300	15.67	17.30	16.43	21.62	20.67	32.43	32.31	56.55	47.86	90.478
400	20.29	30.04	21.30	37.55	26.96	56.32	42.18	98.21	62.91	157.13
500	24.44	46.28	25.70	57.84	32.77	86.77	51.55	151.29	77.42	242.06
600	29.03	66.52	30.55	83.15	39.02	124.72	61.36	217.46	92.39	347.94
700	33.18	89.83	34.94	112.28	44.83	168.43	70.72	293.66	106.90	469.86
800	37.32	174.59	39.34	218.23	50.63	327.35	80.09	570.76	121.41	913.22
900	41.93	195.90	44.20	244.88	56.90	367.32	89.91	640.45	136.40	1024.7
1000	46.07	247.67	48.59	309.59	62.70	464.38	99.28	809.69	150.91	1295.5

ay 30 14:33 K&M Signs Natal

HEIGHT	X	Y	C/L	POS
20	0.036	0.035	134	1
50	0.07	0.066	328	1
100	0.12	0.115	650	1
150	0.175	0.165	973	1
200	0.225	0.215	1302	1
250	0.28	0.265	1625	1
300	0.33	0.315	1947	1
350	0.385	0.365	2274	1
400	0.435	0.415	2596	2
450	0.49	0.466	2919	2
500	0.54	0.515	3241	2
550	0.595	0.565	3564	2
600	0.65	0.615	3886	3
650	0.7	0.666	4209	3
700	0.755	0.715	4531	3
750	0.805	0.765	4854	3
800	0.86	1.22	5176	3
850	0.915	1.22	5499	4
900	0.965	1.22	5822	4
950	1.22	1.22	6144	4
1000	1.22	1.22	6467	4

HEIGHT	X	Y	C/L	POS
20	0.036	0.035	134	1
50	0.07	0.066	328	1
100	0.12	0.115	650	1
150	0.175	0.165	973	1
200	0.225	0.215	1302	1
250	0.28	0.265	1626	1
300	0.33	0.315	1947	1
350	0.385	0.365	2274	1
400	0.435	0.415	2596	2
450	0.49	0.466	2919	2
500	0.54	0.515	3241	2
550	0.595	0.565	3564	2
600	0.65	0.615	3886	3
650	0.7	0.666	4209	3
700	0.755	0.715	4531	3
750	0.805	0.765	4854	3
800	0.86	1.22	5176	3
850	0.915	1.22	5499	4
900	0.965	1.22	5822	4
950	1.22	1.22	6144	4
1000	1.22	1.22	6467	4

HEIGHT	X	Y	C/L	POS
20	0.036	0.035	134	1
100	0.12	0.115	650	1
200	0.225	0.215	1302	1
300	0.33	0.315	1947	1
400	0.435	0.415	2596	2
500	0.54	0.515	3241	2
600	0.65	0.615	3886	3
700	0.755	0.715	4531	3
800	0.86	1.22	5176	3
900	0.965	1.22	5822	4
1000	1.22	1.22	6467	4

STAINLESS 430

HEIGHT	0.9CUT	0.9MAT	1.2CUT	1.2MAT	1.6 C	1.6 M	2.0 C	2.0 M	3.0 C	3.0 M
20	4.01	13.51	4.01	0.29	4.01	0.39	4.06	0.49	4.356	1.59
100	7.33	13.51	7.33	3.21	7.33	4.26	7.58	5.35	9	17.37
200	11.52	13.51	11.52	11.24	11.52	14.99	12.03	18.74	14.668	60.90
300	15.67	13.51	15.67	24.18	15.67	32.21	16.43	40.27	20.873	130.86
400	20.29	13.51	20.29	41.96	20.29	55.94	21.30	69.93	26.964	227.27
500	24.44	13.51	24.44	64.59	24.44	86.18	25.70	107.72	32.769	350.11
600	29.03	13.52	29.03	92.91	29.03	123.88	30.55	154.85	39.024	503.25
700	33.18	13.52	33.18	125.46	33.18	167.29	34.94	209.11	44.629	679.60
800	37.32	13.52	37.32	243.85	37.32	325.13	39.34	406.42	50.634	1320.85
900	41.93	13.53	41.93	273.82	41.93	364.83	44.20	456.04	56.898	1482.13
1000	46.07	13.53	46.07	345.93	46.07	461.24	48.59	576.55	62.703	1873.78

PERSPEC

HEIGHT	3.0C	3.0M	5.0C	5.0M	10C	10M
20	4.01	0.66	4.06	1.03	4.25	2.06
100	7.33	7.16	7.65	11.32	8.47	22.77
200	11.52	25.16	12.16	39.67	13.80	79.82
300	15.67	54.05	16.63	85.24	19.08	171.52
400	20.29	93.87	21.57	148.03	24.84	297.87
500	24.44	144.61	26.04	228.04	30.12	458.87
600	29.03	207.67	30.95	327.80	35.94	659.59
700	33.18	280.71	35.42	442.66	41.12	890.71
800	37.32	545.58	39.86	650.34	46.40	1731.18
900	41.93	612.26	44.81	965.39	52.13	1942.55
1000	46.07	773.97	49.27	1220.49	57.41	2455.86

Other estimates

(4) Screen-printing.

Full Colour = R280 m^2

3 x Colours = R210 m^2

2 x Colour = R180 m^2

1 x Colour = R100 m^2.

(5) Stainless Steel Welding.

? Sorry.

That is all I can give you.

If not sure of anything please phone Brandon

* Att: HEATH *

Brandon Minnie

From: "HE Rogers" <s23125137@tuks.co.za>
To: <brandonm@kmsigns.co.za>
Sent: 30 May 2008 09:21 AM
Subject: Research Project

Hi Brandon. Its good to here that you're well.

Im looking into the amount of outsoucing that K&M Signs does. I need to know how much it costs to outsource crane trucks, digital printing, laser cutting, screen printing and stainless steel welding. I need these prices in unit costs if possible and i also need to know what units are used in these prices.

If you can give me an estimate of how much of these quantities are outsourced each month, it would also be very helpfull.

Thanks for your help.
Heath Rogers
heath@tuks.co.za
0721199512

(1) Crane Trucks ETC.

(2) DIGITAL PRINTING: R200/^{2}m including there substate (vinyl or PVC)

(3) LASER CUTTING: HAVE INCLOSED PRICES OF DIFFERENT SUBSTRATES & PRICE TO cut out letters with the cutting price & material price as per attached C = cutting price M = material.

2008/05/30

Appendix 4: K&M Signs Materials Pricelist Spreadsheet

This is an example and does not contain all the spreadsheets.

K&M SIGNS Price List

Material Category	Material Description	Size			Details	Unit		Rates	Total Cost
	Aluminuim Sheets 1200 H4								
Aluminuim	Aluminuim Sheets 1200 H4	2500	1250	0.5		R/m2		R 46.90	R 0.00
Aluminuim	Aluminuim Sheets 1200 H4	2500	1250	0.7		R/s			R 0.00
Aluminuim	Aluminuim Sheets 1200 H4	2500	1250	0.9		R/m2		R 84.49	R 0.00
Aluminuim	Aluminuim Sheets 1200 H4	2500	1250	1.2		R/m2		R 122.88	R 0.00
Aluminuim	Aluminuim Sheets 1200 H4	2500	1250	1.6		R/m2		R 148.78	R 0.00
Aluminuim	Aluminuim Sheets 1200 H4	3000	1500	1.5		R/m2		R 148.78	R 0.00
Aluminuim	Aluminuim Sheets 1200 H4	2000	1000	2		R/m2		R 186.01	R 0.00
Aluminuim	Aluminuim Sheets 1200 H4	2500	1250	2		R/m2		R 186.01	R 0.00
Aluminuim	Aluminuim Sheets 1200 H4	3000	1500	2		R/m2		R 186.01	R 0.00
Aluminuim	Aluminuim Sheets 1200 H4	2500	1250	3		R/m2		R 279.02	R 0.00
Aluminuim	Aluminuim Sheets 1200 H4	3000	1500	1.6		R/m2		R 148.78	R 0.00
Aluminuim	Aluminuim Sheets 1200 H4	3000	1500	2		R/m2		R 186.01	R 0.00
Aluminuim	Aluminuim Sheets 1200 H4	3000	1500	3		R/m2		R 279.02	R 0.00
Aluminuim	Aluminuim Sheets 1200 H4	2500	1250		Brushing	Per		R 45.00	R 0.00
Aluminuim	Brite Treadplate	2500	1250	1.5		R/m2		R 170.00	R 0.00
	Illuminated Sign Sections					R/m			
Aluminuim	Mae west	6m				R/m		R 61.48	R 0.00
Aluminuim	90mm Sign Section	6m				R/m		R 32.00	R 0.00
Aluminuim	baby h	6m				R/m		R 11.00	R 0.00
Aluminuim	meduim h	6m				R/m		R 17.98	R 0.00
Aluminuim	large h	6m				R/m		R 23.00	R 0.00
Aluminuim	**Engen Aluminuim Extrusion**		R/length			R/m			
Aluminuim	37445	7.1m	R 527.81		Huletts hydro	R/m		R 89.73	R 0.00
Aluminuim	39033	2m	R 157.44		Huletts hydro	R/m			
Aluminuim	37445	2m	R 148.68		Huletts hydro	R/m		R 89.73	R 0.00
	Poster Frame Extrusion								
Aluminuim	44 mm Front Section	4.8 m				R/m		R 28.60	R 0.00
Aluminuim	Std Rear	4.8 m				R/m		R 20.46	R 0.00
Aluminuim	Clips					ea		R 1.06	R 0.00

	Perspex					R/m^2			
Perspex	Clear	3200	1930	3		R/m^2		R 179.00	R 0.00
Perspex	Clear	3200	1930	5		R/m^2		R 274.00	R 0.00
Perspex	Opal and Neutral	3200	1930	3		R/m^2		R 198.72	R 0.00
Perspex	Opal and Neutral	3200	1930	5		R/m^2		R 302.00	R 0.00
Perspex	Opal EXTRUDED	6000	1250	4		R/m^3		R 260.00	R 0.00
Perspex	Colours	3200	1930	3		R/m^2		R 219.00	R 0.00
Perspex	Colours	3200	1930	5		R/m^2		R 337.00	R 0.00
Perspex	Silks	3200	1930	3		R/m^2		R 230.62	R 0.00
Perspex	Silks	3200	1930	5		R/m^2		R 354.00	R 0.00
Perspex	Bisign	3200	1800	5		R/m^2		R 302.16	R 0.00
Perspex	Colours and Bronze 5040	3200	2050	3		R/m^2		R 178.79	R 0.00
Perspex	Colours and Bronze 5040	3200	2050	5		R/m^2		R 274.57	R 0.00
Perspex	Clear 10mm/	2595	1930	10		R/m^2		R 623.00	R 0.00
	CLEAR Plexiglas XT Extruded								
Plexiglas	Clear	2050	1220	1.5 mm		R/m^2		R 101.10	R 0.00
Plexiglas	Clear	3050	2050	1.5 mm		R/m^2		R 101.10	R 0.00
Plexiglas	Clear	2050	1220	2.0 mm		R/m^2		R 134.80	R 0.00
Plexiglas	Clear	3050	2050	2.0 mm		R/m^2		R 134.80	R 0.00
Plexiglas	Clear	3050	2050	3.0 mm		R/m^2		R 161.94	R 0.00
Plexiglas	Clear	3050	2050	4.0 mm		R/m^2		R 221.91	R 0.00
Plexiglas	Clear	3050	2050	5.0 mm		R/m^2		R 247.40	R 0.00
Plexiglas	Clear	3050	2050	6.0 mm		R/m^2		R 296.88	R 0.00
Plexiglas	Clear	2050	1520	8.0 mm		R/m^2		R 419.83	R 0.00
Plexiglas	Clear	3050	2050	8.0 mm		R/m^2		R 419.83	R 0.00
Plexiglas	Clear	2050	1520	10 mm		R/m^2		R 524.79	R 0.00
Plexiglas	Clear	3050	2050	10 mm		R/m^2		R 524.79	R 0.00
Plexiglas	Clear	2050	1520	12 mm		R/m^2		R 674.73	R 0.00
Plexiglas	Clear	2050	1520	15 mm		R/m^2		R 843.41	R 0.00
Plexiglas	Clear	3050	2050	15 mm		R/m^2		R 843.41	R 0.00
Plexiglas	Clear	2050	1520	20 mm		R/m^2		R 1,124.55	R 0.00

	Sign - X								
P V C	White (1240 x 2450)	3 mm				R/m²		R 70.07	R 0.00
P V C	Colours (1240 x 2450)	3 mm				R/m²		R 74.26	R 0.00
P V C	White (1240 x 2450)	4 mm				R/m²		R 82.43	R 0.00
P V C	White (1240 x 2450)	6 mm				R/m²		R 140.38	R 0.00
P V C	White (1240 x 2450)	10 mm				R/m²		R 236.19	R 0.00
P V C	White (1240 x 2450)	3.5 mm				R/m²		R 94.40	R 0.00
	Non Reflec PVC (for posters)								
P V C	Clear Matt	2000	1000	0.5 mm		ea		R 60.10	R 0.00
P V C	Clear Matt	1400	1000	0.5 mm		ea		R 40.50	R 0.00
P V C	Clear Matt	A O		0.5 mm		ea		R 28.20	R 0.00
P V C	Clear Matt	A 1		0.5 mm		ea		R 15.00	R 0.00
P V C	Clear Matt	A 2		0.5 mm		ea		R 5.70	R 0.00
P V C	Clear Matt	A 3		0.5 mm		ea		R 3.75	R 0.00
P V C	Clear Matt	A 4		0.5 mm		ea		R 1.90	R 0.00
	A B S Sheets								
Sheets	WHITE	1250 mm	2500 mm	0.9 mm		R/m²		R 33.18	R 0.00
Sheets	WHITE	1250 mm	2500 mm	1 mm		R/m²		R 36.87	R 0.00
Sheets	WHITE	1250 mm	2500 mm	1.5 mm		R/m²		R 55.30	R 0.00
Sheets	WHITE	1250 mm	2500 mm	2 mm		R/m²		R 73.73	R 0.00
Sheets	WHITE	1250 mm	2500 mm	2.5 mm		R/m²		R 92.16	R 0.00
Sheets	WHITE	1250 mm	2500 mm	3 mm		R/m²		R 110.60	R 0.00
Sheets	WHITE	1250 mm	2500 mm	4 mm		R/m²		R 147.46	R 0.00
Sheets	WHITE	1250 mm	2500 mm	5 mm		R/m²		R 184.33	R 0.00
	U H I								
Sheets	Clear	1250 mm	2500 mm	1.0 mm		R/m²		R 81.91	R 0.00
Sheets	Clear	1250 mm	2500 mm	1.2 mm		R/m²		R 98.30	R 0.00
Sheets	Clear	1250 mm	2500 mm	1.5 mm		R/m²		R 122.87	R 0.00
Sheets	Clear	1250 mm	2500 mm	2.0 mm		R/m²		R 163.83	R 0.00
Sheets	Clear	1250 mm	2500 mm	3.0 mm		R/m²		R 241.62	R 0.00
Sheets	Clear	1250 mm	2500 mm	4.0 mm		R/m²		R 322.16	R 0.00
Sheets	Clear	1250 mm	2500 mm	5.0 mm		R/m²		R 397.45	R 0.00
Sheets	Clear	1250 mm	2500 mm	6.0 mm		R/m²		R 476.95	R 0.00

Vinyls	**Colours**								
Metamark	M4 5 Year Opaque 610 mm	1-19M				R/m		R 21.17	R 0.00
Metamark	M4 5 Year Opaque 1220 mm	1-19M				R/m		R 42.34	R 0.00
Metamark	M7 7-8 Year Opaque 610 mm	1-19M				R/m		R 31.25	R 0.00
Metamark	M7 7-8 Year Opaque 1220 mm	1-19M				R/m		R 62.50	R 0.00
	Translucent					R/m			
Metamark	Colours 610 mm	1-19M				R/m		R 45.00	R 0.00
Metamark	Colours 1220 mm	1-19M				R/m		R 78.60	R 0.00
Metamark	Sandblasted 610 mm	1-19M				R/m		R 46.48	R 0.00
Metamark	Sandblasted 1220 mm	1-19M				R/m		R 92.96	R 0.00
	Black & White					R/m			
L G	Black 1220 mm	50m				R/m		R 43.68	R 0.00
L G	White 1220 mm	50m				R/m		R 43.68	R 0.00
	Reflective					R/m			
L G	LL5000 Ref 5yr Comm 610mm	1-19M				R/m		R 63.84	R 0.00
L G	LL5000 Ref 5yr Comm 1220mm	1-19M				R/m		R 127.68	R 0.00
L G	LL7000 Ref 7yr Engr 610mm	1-19M				R/m		R 74.52	R 0.00
L G	LL7000 Ref 7yr Engr 1220mm	1-19M				R/m		R 149.04	R 0.00
L G	HI8100 Ref 8yr Hi-Intens 610mm	1-19M				R/m		R 121.83	R 0.00
L G	HI8100 Ref 8yr Hi-Intens 1220mm	1-19M				R/m		R 243.66	R 0.00
	CLICKS 106 Briliant Green	1220 mm				R/m		R 172.80	R 0.00
Synchron	PHOTOILLUMINECENT	1016 mm				R/m		R 380.84	R 0.00
Solar Foundati	SILVER WINDOW TINT	1500 mm				R/m		R 74.00	R 0.00
	Wall Paper								
	Matrix Graphite 1300 mm		FOOTPRINT			R/m		R 195.00	R 0.00
	Digital Prints								
Backlit	Printable FLEXFACE 1370 mm	1370 mm				R/m		R 61.65	R 0.00
Backlit	Printable FLEXFACE 2200 mm	2200 mm				R/m		R 99.50	R 0.00
	Flexface								
	Digital Prints		3 R PRINT			R/m²		R 200.00	R 0.00
	Digital Prints		FOOTPRINT			R/m³		R 175.00	R 0.00
Frontlit	Black back matt	1370 mm				R/m		R 29.12	R 0.00
Frontlit	Black back matt	3200 mm				R/m		R 58.24	R 0.00
Frontlit	White back gloss	1370 mm				R/m		R 28.00	R 0.00
Frontlit	White back gloss	3200 mm				R/m		R 55.89	R 0.00
	Flexface Pockets				BOTHMA SIGNS	R/m		R 18.50	R 0.00

Brass	ENGRAVERS BRASS								
Brass	Engravers	2000	600	1.0 mm	Maizey	R/s		R 1,223.10	R 0.00
Brass	Engravers	2000	600	1.2 mm	Maizey	R/s		R 1,455.30	R 0.00
Brass	Engravers	2000	600	1.5 mm	Maizey	R/s		R 1,819.13	R 0.00
Brass	Engravers	2000	600	2.0 mm	Maizey	R/s		R 2,538.00	R 0.00
Brass	Engravers	2000	600	3.0 mm	Maizey	R/s		R 3,807.00	R 0.00
	Brass Sheets								
Brass	Brass Sheet Half Hard	2000	390	0.5 mm	non ferrous	R/s		R 262.50	R 0.00
Brass	Brass Sheet Half Hard	2000	390	0.7 mm	non ferrous	R/s		R 345.00	R 0.00
Brass	Brass Sheet Half Hard	2000	390	0.9 mm	non ferrous	R/s		R 450.00	R 0.00
Brass	Brass Sheet Half Hard	2000	390	1.2 mm	non ferrous	R/s		R 600.00	R 0.00
Brass	Brass Sheet Half Hard	2000	390	1.6 mm	non ferrous	R/s		R 825.00	R 0.00
Brass	Brass Sheet Half Hard	2000	390	2.0 mm	non ferrous	R/s		R 1,012.50	R 0.00
Brass	Brass Sheet Half Hard	2000	390	3.0 mm	non ferrous	R/s		R 1,500.00	R 0.00
						R/s			R 0.00

Stainless	Ba 304 Stainless steel	2500	1250	0.9 mm	Gammid	R/m2		R 171.65	R 0.00
Stainless	BRUSHING	2500	1250		EURO STEEL	R/s		R 50.00	R 0.00
Stainless									R 0.00
Stainless	Ba 304 Stainless steel	2500	1250	0.7 mm	Gammid	R/m2		R 136.17	R 0.00
Stainless	Ba 304 Stainless steel	2500	1250	1.2 mm	Gammid	R/m2		R 230.84	R 0.00
Stainless	Ba 304 Stainless steel	2500	1250	1.5 mm	Gammid	R/m2		R 353.28	R 0.00
									R 0.00
Stainless	Ba 316 Stainless steel	2500	1250	0.7 mm	EURO STEEL	R/m2		R 367.36	R 0.00
Stainless	Ba 316 Stainless steel	2500	1250	0.9 mm	EURO STEEL	R/m2		R 472.00	R 0.00
Stainless	Ba 316 Stainless steel	2500	1250	1.2 mm	EURO STEEL	R/m2		R 645.44	R 0.00
Stainless	Ba 316 Stainless steel	2500	1250	1.5 mm	EURO STEEL	R/m2		R 786.88	R 0.00
Stainless	Ba 316 Stainless steel	2500	1250	2 mm	EURO STEEL	R/m2		R 1,048.96	R 0.00
Stainless	Ba 316 Stainless steel	2500	1250	2.5 mm	EURO STEEL	R/m2		R 1,311.36	R 0.00
Stainless	Ba 316 Stainless steel	2500	1250	3 mm	EURO STEEL	R/m2		R 1,573.76	R 0.00
Stainless	Ba 316 Stainless steel	2500	1250	4.5 mm	EURO STEEL	R/m2		R 2,288.00	R 0.00
									R 0.00
									R 0.00
									R 0.00
									R 0.00
									R 0.00
Stainless	Pipe 304	25mm dia	1.5 mm		Euro Steel	R/m		R 47.00	R 0.00
Stainless	Pipe 304	30mm dia	1.5 mm		Euro Steel	R/m		R 60.00	R 0.00
Stainless	Pipe 304	38mm dia	1.5 mm		Euro Steel	R/m		R 70.00	R 0.00
Stainless	Pipe 304	50mm dia	1.5 mm		Euro Steel	R/m		R 95.00	R 0.00

Appendix 5: Cash flow spreadsheet

Cash flow

	Laser cutter	Digital printer	Screen printer	Crane truck	Welding
Cost	R 360,000.00	R 100,050.00	R 576,375.00	R 450,000.00	R 7,000.00
Interest (Prime)					
1. Current	15.00%	15.00%	15.00%	15.00%	15.00%
2. Recent	12.00%	12.00%	12.00%	12.00%	12.00%
Yearly Payment	R 107,395.20	R 29,846.92	R 171,944.19	R 134,244.00	Once-off
	R 99,867.60	R 27,754.87	R 159,892.19	R 124,834.50	payment
Yearly Savings	R 10,236.73	R 169,180.33	R 26,666.67	R 96,000.00	Unknown
Interest (CPIX)					
3. High	12.00%	12.00%	12.00%	12.00%	12.00%
4. Low	10.00%	10.00%	10.00%	10.00%	10.00%
Maintenance					
Major service	R 15,000.00	R 1,000.00	R 12,000.00	R 15,000.00	R 0.00
Period (Yrs)	3, 6, 9	1, 2, 3, 4	2, 4, 6, 8	2, 4, 6, 8	
		Replace in 5yrs			
Present Worth					
1&3	R -352,981.15	R 786,783.25	R -497,266.43	R 23,353.44	R -7,000.00
1&4	R -370,310.30	R 859,217.58	R -518,433.93	R 42,881.45	R -7,000.00
2&3	R -325,845.83	R 794,324.61	R -453,821.66	R 57,272.58	R -7,000.00
2&4	R -341,774.77	R 867,148.08	R -472,747.36	R 78,550.86	R -7,000.00

Appendix 6: Annual material costs spreadsheet

	Std unit size (m^2)
Sheet metal	3.0625
Vinyl	1.22
Perspex™	5.76

	Expenditure	**Material Qty**		**Material Costs**		**Net Expenditure**
	p.a.	m²/month	units	Cost/unit	Total (R/unit/year)	
Laser cutter	R 12,000.00	4.5	1.47	R 100.00	R 1,763.27	R 10,236.73
Digital printer	R 240,000.00	80	65.57	R 90.00	R 70,819.67	R 169,180.33
Screen printer	R 120,000.00	80	13.89	R 560.00	R 93,333.33	R 26,666.67
Crane truck	R 96,000.00	-	-	-	-	R 96,000.00
Welding	-	-	-	-	-	-