USIZO LOMUSA
FEEDING SCHEME

Business Engineering Model

Final Project Report

November 2014

ArcelorMittal

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

USIZO LOMUSA FEEDING SCHEME

BUSINESS ENGINEERING MODEL

FINAL PROJECT REPORT

compiled by

A.P. BASSON

10038826

submitted in partial fulfilment of the requirements for
the degree of

BACHELORS IN INDUSTRIAL ENGINEERING

in the

FACULTY OF ENGINEERING, BUILT ENVIRONMENT AND INFORMATION TECHNOLOGY

UNIVERSITY OF PRETORIA

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DEPARTEMENT BEDRYFS- EN SISTEEMINGENIEURSWESE
DEPARTMENT OF INDUSTRIAL AND SYSTEMS ENGINEERING

FRONT PAGE FOR FINAL PROJECT DOCUMENT (BPJ 420) - 2014

Information with regard to the dissertation

Title	*USIZO LOMUSA* Feeding Scheme business engineering model
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Date	2014/11/24
Keywords	ArcelorMittal South Africa; *Mobile Feeding Scheme* business engineering model; *USIZO LOMUSA* Feeding Scheme business engineering model; Concept development; Engineering development; Post development; Business engineering model; Business engineering model diet; Mathematical model; Facilities design; Stationary agricultural garden; Stationary kitchen facility; Mobile kitchen unit; Procurement; Logistics and supply chain; Validated; Production; Patent; Stakeholders; Implementation; Financial considerations; Franchise.
Abstract	For the purpose of completing the final project report, with regard to the *USIZO LOMUSA* Feeding Scheme business engineering model, the relevant student had to focus on the development of an economic feasible solution that can be validated. The criteria for the final project report is primarily linked to the ECSA one- and ECSA three exit-level outcomes, which involve the application of problem solving tools and techniques to the project specific environment. It is of utmost importance that creative-, procedural- and/or non-procedural engineering designs are incorporated within the final project report to demonstrate competence.

The *USIZO LOMUSA* Feeding Scheme business engineering model project was instigated by three independent volunteers who are currently preparing two meals per day for a group of specially identified children of Blaauwbosch Primary School, situated within the Osizweni community that is based in Northern KwaZulu Natal. The individuals contacted Mr Mntambo, a CSR (Corporate Social Responsibility) committee member and environmental manager employed at ArcelorMittal Newcastle works, requesting company assistance related to a mobile kitchen unit.

The volunteers intend to use the mobile kitchen unit to generate an additional income in order to subsidize the second meal of each day, since the first is funded by the Department of Education. In several cases it is the only two meals that are provided to the children on a daily basis.

The primary objective of the *USIZO LOMUSA* Feeding Scheme project was to develop a business engineering model that is related to the requested mobile kitchen. However, it was recommended that the relevant comprehensive business engineering model have to be applicable to all schools situated within the Southern African border in need of a feeding scheme. Thus, a business engineering model that is applicable to any school environment was developed and will be validated at the Blaauwbosch Primary School as a first iteration early next year.

The first iteration of the *USIZO LOMUSA* Feeding Scheme, which will be implemented at Blaauwbosch Primary School and the three model specific secondary schools that were identified, promises to provide food to three thousand and thirty four (3034) children.

During the execution period of the *USIZO LOMUSA* Feeding Scheme business engineering model final project report, thorough research was conducted, followed by a detailed investigation of the problem. The concept of the business engineering model was explored and clearly defined before the student attended to the advanced development, engineering design and evaluation of the project. In conclusion, the student considered numerous aspects related to the and post development of the project. The final project report will be summarised in a user manual format, for the future expansion of the *USIZO LOMUSA* Feeding Scheme business engineering model.

	When one candle lights another, it will not lose any of its power to produce light. Although a feeding scheme as proposed will not deliver visible profit margins as a business enterprise should, the result of this venture lead to a healthier and better educated work force that will only positively be experienced in years to come. The potential financial gain the country will experience at that point in time will be immeasurable. Many candles (feeding schemes) will undoubtedly enlighten the lives of several children in need and will eventually lead to a brighter and prosperous future.
Category(s)	Primarily: Business Modelling, Facilities Planning and Operations Research.

Declaration

1. I understand what plagiarism is and I am aware of the University's policy in this regard.

2. I declare that this is my own original work

3. Where other people's work has been used (either from a printed source, internet or any other source) this has been carefully acknowledged and referenced in accordance with departmental requirements

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ACKNOWLEDGEMENTS

EXECUTIVE SUMMARY

Project (BPJ 410) is an obligatory first semester module for all final year Industrial Engineering students studying at the University of Pretoria. The successful completion of the mentioned pre-requisite module automatically enables the relevant final year Industrial Engineering students to continue with *Project* (BPJ 420), presented during the course of the second semester in the final year of studies. Both modules mentioned, are mandatory in order to obtain a Bachelors in Industrial Engineering.

The primary objective of the two consecutive modules stated above, is to provide an opportunity for each Industrial Engineering student at undergraduate level, to apply the fundamental knowledge and techniques gained throughout the duration of the Bachelor's Degree. Thus, competency can be demonstrated, which is a requirement of multiple ECSA exit-level outcomes.

The sequential modules consist of a number of phases. The project topic selection, project proposal and preliminary project report, over and above a verbal presentation of the final project report, form part of the module *Project* (BPJ 410). Whilst the intermediate project report, the final project report, the construction of a poster and an oral presentation are requirements of the *Project* (BPJ 420) module.

For the purpose of completing the final project report, with regard to the *USIZO LOMUSA* Feeding Scheme business engineering model, the relevant student had to focus on the development of an economic feasible solution that can be validated. The criteria for the final project report is primarily linked to the ECSA one- and ECSA three exit-level outcomes, which involve the application of problem solving tools and techniques to the project specific environment. It is of utmost importance that creative-, procedural- and/or non-procedural engineering designs are incorporated within the final project report to demonstrate competence.

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KEYWORDS

ArcelorMittal South Africa; *Mobile Feeding Scheme* business engineering model; *USIZO LOMUSA* Feeding Scheme business engineering model; Concept Development; Engineering Development; Post Development; Business Engineering Model; Business Engineering Model Diet; Mathematical Model; Facilities Design; Stationary Agricultural Garden; Stationary Kitchen Facility; Mobile Kitchen Unit; Procurement; Logistics and Supply Chain; Validated; Production; Patent; Stakeholders; Implementation; Financial Considerations; Franchise.

PROJECT SPECIFICS

Title of Treatise:	*USIZO LOMUSA* Feeding Scheme Business Engineering Model
Name of Author:	A.P. (Anneri) Basson
Name of study leader:	Prof P.S. Kruger
Institution:	Department of Industrial and Systems Engineering, Faculty of Engineering, Built Environment and Information Technology, University of Pretoria
Project Sponsor:	ArcelorMittal Newcastle works
Sponsor representative:	Mr S. Mntambo
Date:	November 2014
NOTE:	The signed Industry Sponsorship Form is included within the Project Proposal Appendix A.

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LIST OF ABBREVIATIONS

AC	Alternating Current
AHP	Analytic Hierarchy Process
ASSA	Actuarial Society of South Africa
B-BBEE	Broad-Based Black Economic Empowerment
BEP	Break Even Point
BMR	Bureau of Market Research
BSC	Balanced Scorecard
CD	Compact Disc
CSR	Corporate Social Responsibility
DIY	Do It Yourself
dti	Department of Trade and Industry
DWQ	Division of Water Quality
ECSA	Engineering Council of South Africa
EFT	Electronic Funds Transfer
FASA	Franchise Association of Southern Africa
FCD	Foodstuffs, Cosmetics and Disinfectants
FLAG	Food Legislation Advisory Group
GFSI	Global Food Safety Initiative
HACCP	Hazard Analysis and Critical Control Points
ILP	Integer Linear Programming
JSE	Johannesburg Stock Exchange
KPI	Key Performance Indicator
LNM	Lebanese National Movement
MIP	Mixed Integer Programming
NGO	Non-Governmental Organisation
OHSA	Occupational Health and Safety Act
PV	Photovoltaic
R&D	Research and Development
SABS	South African Bureau of Standards
SASSA	South African Social Security Agency
SCOR	Supply-Chain Operations Reference model
SQF	Safe Quality Food Standard Certification
TPS	Toyota Production System
UNISA	University of South Africa
VAT	Value Added Tax
WBS	Work Breakdown Structure
WWF-SA	World Wildlife Fund of South Africa
2WD	Two-Wheel Drive

4WD   Four-Wheel Drive

4W-ABS   Four-Wheel Anti-Lock Braking System

NOMENCLATURE LIST

Symbol	Description	Applicable units
cm	length	centi metre
m	length	metre
m^2	surface area	square metre
m^3	volume	cubic metres
km	length	kilo metre
h	surface area	hectares
ml	liquid	milli liter
l	liquid	liter
l^3	liquid	cubic liter
g	weight	gram
kg	weight	kilogram
t	weight	ton
rpm	tongue	revolutions/metre
Nm	tongue	Newton/metre
W	electricity	Watt
kW	electricity	kilo Watt
V	electricity	Volt

NOTE:

1 Foot	=	30 cm
12 Thumb	=	1 Foot
2.5 cm	=	1 Thumb

1   Introduction

1.1   Background

The following sub-sections will provide: a brief background associated with the establishment of ArcelorMittal South Africa, an overview of ArcelorMittal Newcastle works, the current community based projects initiated by the ArcelorMittal Group and lastly, information relating to the requested *Mobile Feeding Scheme* business engineering model will be revealed.

1.1.1   ArcelorMittal Group

1.   ArcelorMittal South Africa general company profile

ArcelorMittal South Africa, previously known as Iscor, was established in the year 1928 and was originally located in Pretoria. The primary objective of the company was to create job opportunities within South Africa, over and above the production of iron and a large range of steel products.

Due to the high demand in heavy plates for ship repairs and the manufacturing of armoured cars with the declaration of war, the Vanderbijlpark works was commissioned in 1943. However, it was only after the war that a fully integrated steel works was developed at Vanderbijlpark.

The Vanderbijlpark works was followed by the construction of an integrated steel works at Newcastle in 1971.

In the years that followed, Iscor was privatised, where after Iscor Limited shares were listed in the Steel and Allied section of the Johannesburg Stock Exchange (JSE).

The late nineteen hundreds involved the addition of Vereeniging works, in a joint venture to realise the construction of the Saldanha Steel Mill that was commissioned in 1998.

During December 2001, the Iscor steel and mining groups were separated into two listed mining and steel companies - known as Kumba Resources and Iscor. The mines, which were previously developed by Iscor, for the mining of coal, zinc, iron ore and industrial minerals used in the production of steel, were allocated to the Kumba Resources extension.

Iscor attained full control over the Saldanha Steel Mill at the end of 2002 and in the subsequent year, LNM bought a R1.8-billion partial buy-out share in Iscor-Limited. The company was renamed to Ispat Iscor Limited that same year.

During 2004, Ispat International NV acquired LNM Holdings NV, which is the parent company of Ispat Iscor. It was only after the acquisition that the company name has changed to Mittal Steel Company NV in 2005.

Mittal Steel and ArcelorMittal Steel South Africa merged in October 2006 and commenced trading under the name: ArcelorMittal South Africa.

Currently, ArcelorMittal South Africa Limited is not only the largest steel producer on the African continent, but forms part of the ArcelorMittal Group, which is the world's number one steel manufacturer providing job opportunities to approximately three hundred and sixteen thousand (316 000) people worldwide.

The ArcelorMittal Group is known as the leader in all major global markets, which includes the construction- and automotive industry, household appliances and packaging. The company has a balanced geographic diversity in both developing and developed markets and is well represented across Europe, America, Asia and Africa.

2.   ArcelorMittal Newcastle works

ArcelorMittal Newcastle works, which is situated in the northern region of KwaZulu Natal, is known as the leading South African provider of steel profile products.

Leading commodities rated ArcelorMittal Newcastle works among the lowest billet cash to cost producers in the world. This low cost, highly efficient operations were the result of intensive re-engineering programmes executed throughout ArcelorMittal South Africa.

Annually, ArcelorMittal Newcastle works manufacture an estimated 1.9 million tonnes of final profile products, for both local- and international markets. The profile products include low- and medium carbon commercial grades, low carbon rimming steel substitutes, sulphur containing free-cutting steels, micro alloyed steels, high carbon wire-rod steels and finally low-, medium- and high alloy steels.

ArcelorMittal Newcastle works is currently in the process of executing an extensive refurbishment, in order to optimise operations. The completion of the refurbishment will ensure sustainable global competitiveness, at all levels.

3.   Current community based projects initiated by the ArcelorMittal Group

The result of ArcelorMittal South Africa acknowledging the fact that the South African government cannot single-handedly accept the responsibility for social development in the country, was the establishment of a Corporate Social Responsibility (CSR) extension within the company, which is in line with the ArcelorMittal company value *Sustainability*.

The Corporate Social Responsibility (CSR) is underpinned by several principles and promise to facilitate a closer engagement with stakeholders to ensure a sustainable contribution to the development of local communities through the investment of time, knowledge and appropriate skills.

The Corporate Social Responsibility (CSR) main focus areas include:

- Education
- Heath safety
- Social upliftment

ArcelorMittal South Africa are currently involved in numerous projects titled: Science Centers, School Building Project, Collect-a-Can and Solidarity Holidays.

ArcelorMittal South Africa frequently work together with Solidarity and Social Services, driving numerous projects aimed to improve and uplift the disadvantaged communities in which the company operates.

Recently, a number of special manufactured houses imported from France were constructed within the informal settlements of Madadeni and Osizweni, situated within the borders of the Newcastle municipality. The houses were built as part of the Solidarity Holidays project, where ArcelorMittal employees from all over the world were given the opportunity to come and help assemble the prefabricated houses on company expense. The complete houses, as illustrated in Figure 1B, were allocated to less fortunate people identified within the specified community with the help of Social Services.

Figure 1A

Grandmother and her fifteen grandchildren - in need of a house.

Figure 1B

One of the prefabricated houses constructed by ArcelorMittal, for the less fortunate people in their direct communities.

Figure 1 Current ArcelorMittal community based project in Newcastle

1.1.2 *Mobile Feeding Scheme* business engineering model

As a world leading steel company, the ArcelorMittal Group is known to support large scaled community based projects. The primary objective of their involvement is to acknowledge communities for their participation across many different sectors within the company and in several different countries.

At the beginning of this year three independent volunteers at a local school situated within the Osizweni community, which forms part of the Newcastle municipal district, contacted Mr Mntambo - the environmental manager at ArcelorMittal Newcastle works. Mr Mntambo is partly responsible for the local community based projects executed by ArcelorMittal South Africa. The parties informed Mr Mntambo that they are in need of a mobile kitchen.

The three individuals are currently preparing two meals per day for a group of identified children at the Blaauwbosch Primary School. The first meal of each day is subsidized by the Department of Education, whilst the second meal (which is mainly provided to the orphan children educated at the relevant school) is paid for out of their own pockets.

There are approximately six schools situated within a radius of five kilometres. The three volunteers who are committed to the further education of the children, would like to use the mobile kitchen to sell lunch combos to the teachers of the nearby situated schools, in order to raise enough funds to subsidize the second meal of each day. For several orphan children, it is the only two meals the children are provided on a daily basis.

They currently have the facilities to prepare food for a limited number of people in a stationary kitchen of approximately eighty (80) square metres in size, which is situated in one of the classrooms at the Blaauwbosch Primary School. Furthermore, the volunteers informed Mr Mntambo that the Blaauwbosch Primary School has unutilized land (of approximately two hectares) available for agricultural purposes, together with two, two thousand two hundred (2 200) liter JoJo tanks donated by the Department of Education. The land and present available equipment illustrated in Figure 2, can surely contribute to the entire feeding scheme.

Figure 2A
Photo partially indicating the unutilized land at the Blaauwbosch Primary School.

Figure 2B
The JoJo tanks provided by the Department of Education.

Figure 2 Photographs indicating Blaauwbosch Primary School specifics

The Industrial Engineering student, who is a bursary holder of ArcelorMittal, visited the Blaauwbosch Primary School earlier this year, accompanied by a panel of authorities involved in the company related community based projects.

Considering the current situation of the pupils at the Blaauwbosch Primary School, the possible application of a business model related to the requested mobile kitchen will surely have a direct positive influence on the learning abilities, in addition to the physical capabilities of each child. Since the Corporate Social Responsibility (CSR) of ArcelorMittal South Africa has a particular emphasis on education, the implementation of a project of this nature, is highly recommended.

1.2 Problem Statement

The problem statement section includes the declaration of the problem identified by Mr Mntambo, a brief discussion of the problem stated, the problem specific area of application and an overview of the nature of the project.

1.2.1 Identification of the Problem

The voluntary, independent individuals who are currently preparing two meals per day at the Blaauwbosch Primary School, situated within the Osizweni community, are in need of a mobile kitchen. The individuals intend to use the mobile kitchen to sell lunch combos to the teachers of nearby situated schools, in order to raise enough funds to subsidize the second meal of each day, which is specifically prepared for a smaller group of recognized children. As previously stated, in several cases it is the only two meals provided on a daily basis, to this specific group of pupils.

Mr Mntambo, the environmental manager at ArcelorMittal Newcastle works, is partly responsible for the local community based projects executed by ArcelorMittal South Africa. He suggested that the mobile kitchen rather be used to mainly supply the pupils of the Blaauwbosch Primary School and nearby situated schools with food.

Thus, the student is required to develop a business engineering model that is related to the requested mobile kitchen problem. The business model should include: the proposal of a balanced diet, the design of a feasible stationary agricultural garden, the layout of both a stationary kitchen and mobile kitchen unit, the supply chain channel to be followed, all relevant work flow and systems involved, a procurement schedule and lastly, a feasibility assessment.

Additional facets that need to be included within the business engineering model: the production of the mobile kitchen unit, all aspects related to the success of daily operational processes, necessary procedures for the registration of a patent, the identification of possible stakeholders, financial considerations, implementation schedules and procedures, and lastly the registration of a non-profit franchise need to be considered in order to complete the business engineering model.

Furthermore, it is recommended that the comprehensive business engineering model to be developed, is applicable to all South African schools in need of a feeding scheme (stationary and/or mobile).

Thus, it can be concluded that the business engineering model will be implemented and validated at the Blaauwbosch Primary School as a first iteration, where after it can be applied at every single South African school in need of a feeding scheme.

1.2.2 Area of Application

Definite decisions related to the particular project area of application, regarding the possible implementation of the *Mobile Feeding Scheme* business engineering model, could include verdicts between rural areas or informal settlements and communities or schools. Since the primary necessity of communities situated within rural areas differ from those of communities located within informal settlements, this decision could influence the entire business model henceforth.

Due to the fact that the independent volunteers of the local school situated within the Osizweni informal settlement contacted Mr Mntambo to convey their request for a mobile kitchen, the verdicts previously mentioned no longer exist.

The area of application for the *Mobile Feeding Scheme* business engineering model can be summarized as follow: the business engineering model have to specifically address the needs of children registered at South African schools. Although the first iteration of the business engineering model will be validated at the Blaauwbosch Primary School, which is situated within an informal settlements, the model will be viable to any school in need of a feeding scheme (both stationary and/or mobile).

1.2.3 Nature of the Project

The allocated final year project requires the development of a business engineering model that is applicable to all South African schools in need of a feeding scheme, which is either stationary or mobile in order to serve additional schools within the direct community. A clear definition of the business model boundaries, specifications regarding the basic structure of the model, a thorough investigation of current business behaviour and finally, the restructuring of information and a concluded business model, is required.

1.3 Project Rationale

During 2011, the relevant student completed the *Community Based Project* (JCP 210) module, which is compulsory for all second year Engineering students studying at the University of Pretoria. For the duration of the module the student was engaged at the Sinqobile Combined School, situated in Northern KwaZulu Natal. The module requirements included the creation of a blog, representing the community based project, which can be accessed through the University of Pretoria web page or by typing the following link into the internet browser:

http://sinqobilecombinedschool.wordpress.com/

In the subsequent years, a number of comments were posted on the Sinqobile Combined School blog. Hence, the student came to the conclusion that there are a high demand for community orientated projects, since some blog readers enquired about the possibility of donating towards this specific cause.

The visit to the Blaauwbosch Primary School earlier this year, once again reminded the student that a single person who is eager to dare and bear the risk, can change the lives of multiple people. Consequently, the student agreed upon developing the comprehensive *Mobile Feeding Scheme* business engineering model as a final year project, although it will require hard work and perseverance.

Nolan Bushnell once said that "Everyone who has ever taken a shower has had an idea. It's the person who gets out of the shower, dries off, and does something about it that makes a difference".

1.4 Definition of a *Mobile Feeding Scheme*

For the purpose of demonstrating a clear understanding of what the *Mobile Feeding Scheme* project entails, the word phrase *Mobile Feeding Scheme* had to be defined through obtaining a definition for each individual word. A combined phrase definition were developed, once each individual word was defined.

According to the Oxford English Dictionary, each of the following words can be defined as:

Mobile:

1. [usually before noun] that is not fixed in one place and can be moved easily and quickly: *mobile equipment*, a *mobile shop/library* (= one inside a vehicle).
2. [not usually before noun] (of a person) able to move or travel around easily: *a kitchen especially designed for the elderly or people who are less mobile*, *you really need to be mobile* (= have a car) *if you live in the country*.
3. (of people) able to change your social class, your job or the place where you live easily: *a highly mobile workforce* (= people who can move easily from place to place).
4. (of a face of its features) changing shape or expression easily and often.

Feeding:

the act of giving food to a person, an animal or a plant: *breast/bottle feeding.*

Scheme:

1. (for doing sth)|(to do sth) a plan or system for doing or organizing sth: *a training scheme, a local scheme for recycling newspapers, to **introduce/operate a scheme** to improve links between schools and industry*, under the new scheme only successful schools will be given extra funding.
2. a plan for getting money or some other advantages for yourself, especially one that involves cheating other people: *an elaborate scheme to avoid taxes.*

The definitions obtained for each of the above distinctive words, enabled the student to define the complete word phrase *Mobile Feeding Scheme*, within the context of the Industrial Engineering final year community based project.

A *Mobile Feeding Scheme* can be defined as a plan or system which entails the act of giving food to people using a mobile kitchen unit that is not fixed in one place and can be moved easily and quickly.

1.5 Project Aim

The primary objective of the *Mobile Feeding Scheme* project is to develop a business engineering model that is related to the requested mobile kitchen. The business engineering model should be capable of providing food to the pupils of the Blaauwbosch Primary School, along with the learners of the three nearby identified schools. Furthermore, the business engineering model have to be applicable to all South African schools in need of a feeding scheme, whether it is a stationary- and/or mobile feeding scheme.

The development of a stationary agricultural garden, in aid of the *Mobile Feeding Scheme*, have to be included in the business engineering model. A linear mathematical model must be programmed to determine the exact input quantities of raw materials for the stationary agricultural garden. It is of utmost importance that the stationary agricultural garden is located near the stationary kitchen facility.

For the purpose of developing a significant comprehensive business engineering model that is directly related to the *Mobile Feeding Scheme*, a number of additional activities have to be included in the project aim. Therefore, the following list of activities will be executed during the development of the *Mobile Feeding Scheme* business engineering model:

- Calculations related to the optimal location of the stationary kitchen- and stationary agricultural garden facilities.
- The generation of a balanced diet formulated by a specialist in that particular field.
- The design of a feasible stationary agricultural garden and the layout of the two additional facilities (the stationary kitchen and the mobile kitchen unit).
- The complete design of all logistics and supply chain related activities.
- The generation of a procurement schedule.
- Lastly, the execution of a feasibility assessment.

Although the workload stated above is adequate for the successful completion of an Industrial Engineering final year project, the relevant student decided upon carrying out two additional sections that will henceforth be referred to as *phases*. The purpose for adding two supplementary phases is to provide ArcelorMittal Newcastle works with a complete business engineering model that is ready for implementation. The activities previously listed, will be regarded as the project phase one (phase I).

The second- and third phase (phase II and III) of the project will entail the production of the mobile kitchen unit, all relevant aspects to consider in order to ensure the success of the *Mobile Feeding Scheme* daily operations, necessary procedures for the registration of a patent, the identification of potential stakeholders, financial considerations, implementation schedules and procedures, and finally, the registration of a non-profit franchise.

The model to be developed as a final year project, will be implemented and validated at the Blaauwbosch Primary School as a first iteration. The further implementation of the *Mobile Feeding Scheme* business engineering model at other South African schools, will only proceed once the first application of the business engineering model is approved.

Finally, the student responsible for the development of the *Mobile Feeding Scheme* business engineering model aims to use the systems engineering method top-level flow diagram illustrated in Figure 3, for the structuring of the project report. This will enable the student to address the need, requirements, functions, the system model and ultimately, the solution(s), sequentially.

Need

Requirements Analysis

Requirements

Functional Definition

Functions

Physical Definition

System Model

Design Validation

Solution
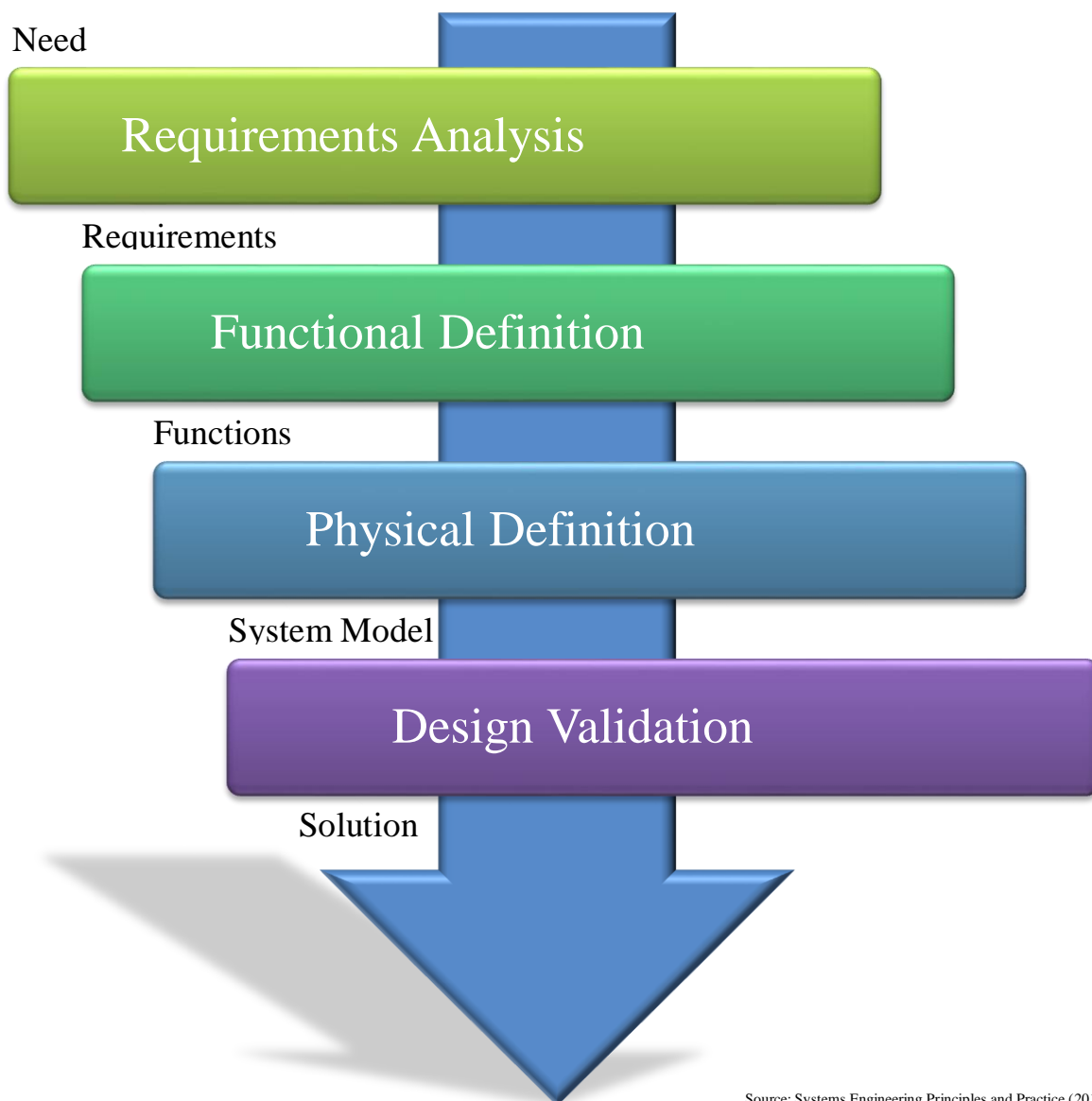
Source: Systems Engineering Principles and Practice (2011:92).

Figure 3 Systems Engineering method top-level flow diagram

1.6 Project Approach

The successful completion of the comprehensive business engineering model, related to the student final year project, requires a number distinctive activities and tasks that need to be executed throughout the duration of the project.

As previously mentioned, in the project report section titled *project aim*, the *Mobile Feeding Scheme* business engineering model project was divided into three primary phases. The system life cycle model provided in Figure 4, served as a guideline for the allocation of the three project phases along with their associated activities. Thus, it can be stated that phase I involves the concept development-, phase II the engineering development- and lastly, phase III the post development of the *Mobile Feeding Scheme* business engineering model.

The first phase (phase I) is the primary phase, which will be addressed during the course of the first module *Project* (BPJ 410). Phase two and -three (phase II and phase III) will be attended to during the June-vacation and the execution of the second module *Project* (BPJ 420).

Figure 4 System life cycle model

A complete Work Breakdown Structure (WBS), indicating the organisation of all the relevant phases in which each activity will occur during the duration of the final year project, can be seen in Appendix B.

Furthermore, Figure 5 included within the following project report section titled *project scope and deliverables*, is a graphical representation of all the activity related tasks to be completed during the course of *Project* (BPJ 410) and *Project* (BPJ 420).

The hypothesis concerning the successful completion of the student final year project, involves the execution of all activities and tasks using the following sequence:

1. Establishment of a two week cycle diet, with the help of a dietitian.
2. The development of the mathematical model related to the stationary agricultural garden.
3. Facilities design (stationary agricultural garden, stationary kitchen and mobile feeding scheme unit).
4. Design of logistics and supply chain.
5. Development of procurement schedule.
6. Conduct feasibility assessment.
7. Considerations regarding the production of the *Mobile Feeding Scheme* unit.
8. Operational process development.
9. Investigation related to patents.
10. Identification of stakeholders.
11. Financial considerations and proposals.
12. Implementation procedure and related schedules.
13. Establishment of a non-profit franchise.

1.7   Project Scope and Deliverables

The project scope and deliverables section of the project report involves an outline of the exact business engineering model boundaries applicable and a declaration of the results that can be expected once the execution of the *Mobile Feeding Scheme* business engineering model project is completed.

The development of the business engineering model, will be based on thorough literature study, forecasted demand figures and research related to the specific consumer needs. This will enable the student to generate a business engineering model that is applicable to the learners of any South African School challenged by similar circumstances.

The first iteration of the business engineering model will assure the children of Blaauwbosch Primary school and the three nearby situated schools, with a minimum of two balanced meals per day. An alternative feasible solution should be obtained, if the two balanced meals cannot be guaranteed on a daily basis.

The calculation of the geographic optimal location with regard to the stationary agricultural garden- and kitchen facilities in the *Mobile Feeding Scheme* project, will not be considered for the first iteration of the business engineering model at Blaauwbosch Primary School and the three identified neighboring schools. The decision was based on the fact that the existing facilities at Blaauwbosch Primary School is satisfactory, although adjustments and modifications might be desirable.

A mathematical model (using linear programming, integer linear programming (ILP) or mixed integer programming (MIP)) will be formulated, once a two week cycle diet has been established. The mathematical model will be used to generate the exact input quantities for the variety of products to be planted in the stationary agricultural garden, to enable the feeding scheme to be both feasible and sustainable.

The mathematical model must be capable of minimizing the total cost involved, with regard to the *Mobile Feeding Scheme* business engineering model. Furthermore, the mathematical model have to include all necessary constraints, of which the primary limitation will be the amount (in ZAR) obtained from government funding. As previously stated, the money received by the South African government is used to subsidise the first meal of each day at Blaauwbosch Primary School.

The suggested new generation optimization software function called *Solver* in Microsoft Office Excel, will be used to systematically solve the input quantities of the real-life *Mobile Feeding Scheme* problem. Concluding decisions and recommendations concerning the development of the business engineering model and the future procurement of raw materials, will be based on the results obtained using the mathematical model.

A detailed overview of the results that can be expected from each of the relevant *Mobile Feeding Scheme* business engineering model project phases, include:

- The *first* phase (phase I) will primarily entail the concept development, the design of the specified facilities (the static stationary agricultural garden, the stationary kitchen and mobile feeding scheme unit) using a number of Industrial Engineering techniques, including *AHP* analysis and facilities planning. The logistics and supply chain related to the feeding scheme will be established. The procurement schedule based on the results obtained from the mathematical model. A feasibility test has to be conducted, in order to ensure that crops (the raw materials) are not planted at a higher cost than that for which the final product can be purchased from a local retailer.

- The production of the mobile kitchen unit, which is part of engineering development, will be investigated within the *second* phase (phase II) of the project. For the purpose of the *Mobile Feeding Scheme* business engineering model, the activities and tasks related to the execution of the second phase will be outsourced. The deliverables of phase II will thus entail recommendations with regard to possible manufacturers for the mobile kitchen unit and features to be included in the mobile kitchen unit.

- During the *third* phase (phase III), in which post development activities are considered, a list of requirements should be established: area specific variables, sustainable farming practices, shift structures, work design (ergonomics), performance ratings and allowances, relevant legislation, associated training, balanced scorecards, invoicing and disaster management.

  Research related to patents and patent rights need to be considered. Possible stakeholders, within a number of sectors, have to be identified. All variable and fixed financial aspects related to the *Mobile Feeding Scheme* business model have to be addressed. The implementation procedure and scheduling associated with the implementation process has to be stated. Lastly, the possibility of transforming the business concept into a non-profit franchise have to be considered.

Figure 5, on the next page, is a graphical representation of all the activity related tasks to be completed during the course of *Project* (BPJ 410) and *Project* (BPJ 420). The process map figure was compiled using Microsoft Office Visio.

Mobile Feeding Scheme - Business Engineering Model

Phase I

Design – Usizo Feeding Scheme Model

- Two week diet cycle
- Geographical optimal location of the agricultural garden and stationary kitchen
- Agricultural garden
- Facilities: agricultural garden, stationary kitchen facility and mobile unit
- Supply chain and logistics
- Workplace equipment and tool design, together with work flow and systems safety.
- Procurement schedule
- Financial considerations (feasibility test and/or assessment)

Financial considerations

- Initial cost (mobile unit manufacturing costs, development of agricultural garden, relevant facilities - fixed and variable cost)
- Annual operating cost
- Cost related to patent rights
- Job creation
- Financial proposal and/or resolution for stakeholders

Implementation

- Implementation procedure
- Implementation schedule

Phase II

Production - Mobile Unit

- ISO regulations
- Methods for manufacturing mobile unit
- Possible manufacturers (3PLs: Echo 4x4, Private manufacturer)
- Quality assurance of manufacturing line
- Legal documentation
- Construction and testing

Stakeholders

- ArcelorMittal South Africa
- Government
- Solidarity
- Privately owned companies
- Donations form private entities

Franchise - non profit organisation

- Process related to registering a Franchise
- Franchise related legislation

Phase III

Operational process development

- Calculations of the geographical optimal location of stationary facilities
- Area specific variables for the Usizo Iomusa feeding scheme model
- Sustainable farming practices
- Legislation (work design/ergonomics, performance ratings and allowances, workplace and systems safety, shift structures, employee contracts.)
- Training
- Balanced scorecards
- Invoicing
- Disaster management

Patent

- Procedure of registering a patent
- Patent registration related legislation

Figure 5 A process map representing all activity related tasks

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2 Literature Review

The *literature review* section of the *Mobile Feeding Scheme* business engineering model project is an informative part of the final project report that is essential in order to gain a clear understanding of the project motives and reasoning.

2.1 Tools and Techniques

As previously mentioned, a number of appropriate tools and techniques were identified for the development of the *Mobile Feeding Scheme* business engineering model. The tools and techniques will be used to understand, measure, define fundamental concepts and lastly, improve profitability. Within the following sections the tools and techniques to be used, in order thoroughly analyzed the problem formerly mentioned in the problem statement of the final project report, are listed in alphabetical order.

2.1.1 Analytic Hierarchy Process (AHP)

The Analytic Hierarchy Process (AHP) was formerly developed by Thomas Saaty to provide an effective tool to assist with complex decision making, which involves multiple criteria. The method in which AHP is applied entails the identification and weight allocation of selection criteria in addition to the analysis of the data that was collected, which will ultimately enable the user to expedite the decision making process.

Numerous steps can be identified in order to successfully execute the AHP process. The first step will require the decomposition of the primary objective into constituent parts. The AHP process represents a single goal, general to specific criteria and alternative process levels in its simplest form. The second step will include the sub-division of the set of alternatives into appropriate levels of detail. It is important to keep in mind that the more criteria included, the less weight each individual criteria would carry. Figure 6 is a graphical representation of the steps described up to this point.

A relative weight need to be assigned to each of the identified criteria within the third step. Each criteria consist out of a local, which is often referred to as an immediate criteria, and a global priority. The global priority gives an indication of the relative importance within the overall AHP process model. The sum of all the criteria stated below the primary, parent criteria in each tier must be equal to the value of one.

The last step within the AHP execution process, after the criteria are weighted and relevant data were obtained, would be to include the information in the AHP model. The numerous choice scoring have to be compared on a relative basis and computed within the individual leafs of the hierarchy model. Summed scores will then be generated as a result, yielding a composite score for each row choice, in addition to an overall score.
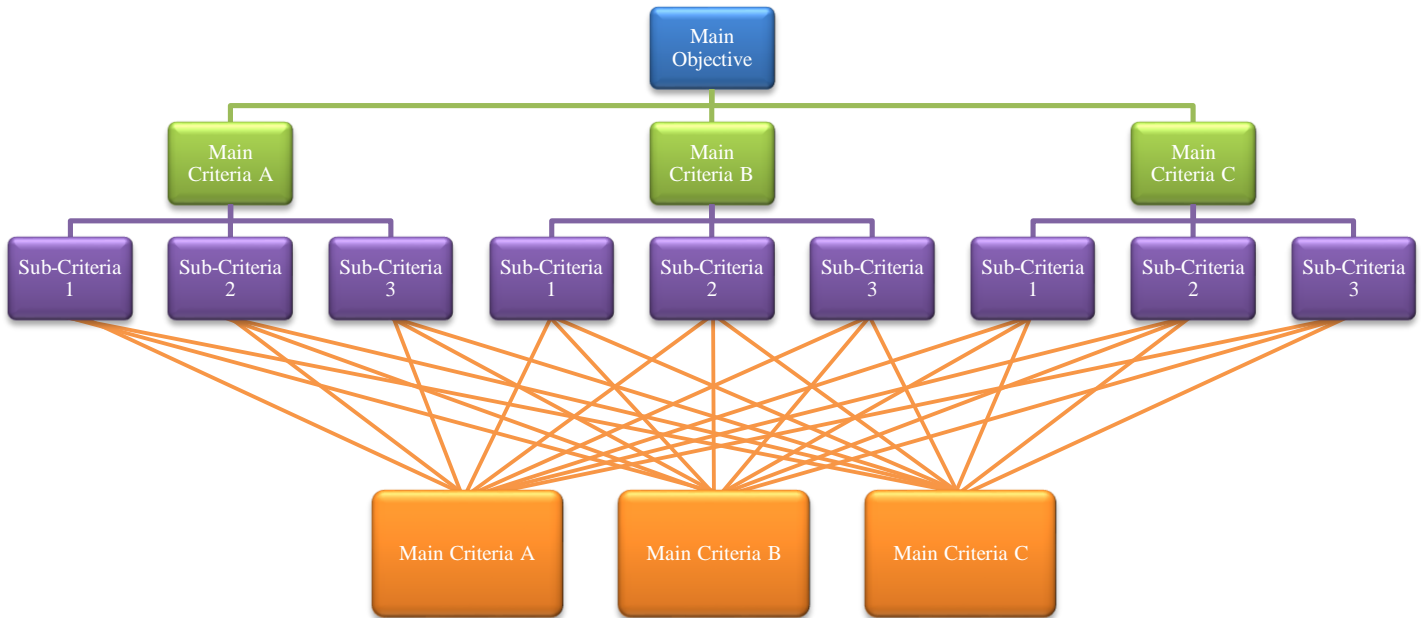
Figure 6 Graphical representation of the AHP process

2.1.2 Balanced Scorecard

The primary objective of the strategic planning and management tool, known as a balanced scorecard, is to transform the complex vision and mission of an organisation into a comprehensible practical system including performance measures and/or priorities.

Once the transformation is completed, it is of utmost importance to communicate the associated priorities to all the levels within the organisation. For the communication to be effective, communication has to be conducted in such a way that each employee can see and understand how their specific work will contribute towards the success of the organisation.

The balanced scorecard technique specifically considers four primary views of an organisation that can be listed as follow: customer, financial, internal processes, and lastly, learning and growth.

The balanced scorecard tool is applicable to a wide range of businesses, companies and originations related to government, the industry and non-profit organisations.

2.1.3 Business Engineering Modelling

Business models were already developed in the earliest days when businesses originated. A business model can either be simple or extremely complex. It is of utmost importance that a business model satisfy customer demand or else the sole purpose of increasing the profit margin using the principle of the higher-the-better, will not be met.

According to research, a business model can be described as a model that is specifically engineered to ensure the generation of revenue and to maximise profit. The model includes all the business functions and components, in addition to their associated revenues generated or the related expenses incurred.

For the purpose of the *Mobile Feeding Scheme* business engineering model project, a business model will be used to synchronize all related operations and activities. However, a profit may not be generated, since it is a community based orientated project. Should a profit be made, the money can be used for annual maintenance to assets and/or fixed facilities, else the money can be donated towards similar community based projects.

2.1.4 Business Strategy

During the course of the second semester *Business Engineering* (BPZ 421) module, the lecturer introduced a number of aspects or tools that need to be defined in order to ultimately derive a business strategy. The numerous aspects include PESTLE analysis, Porter's Five Forces, the seven S's, SWOT analysis and lastly, scenario planning. A geographical representation of each of the tools mentioned, can be viewed in Figure 7.
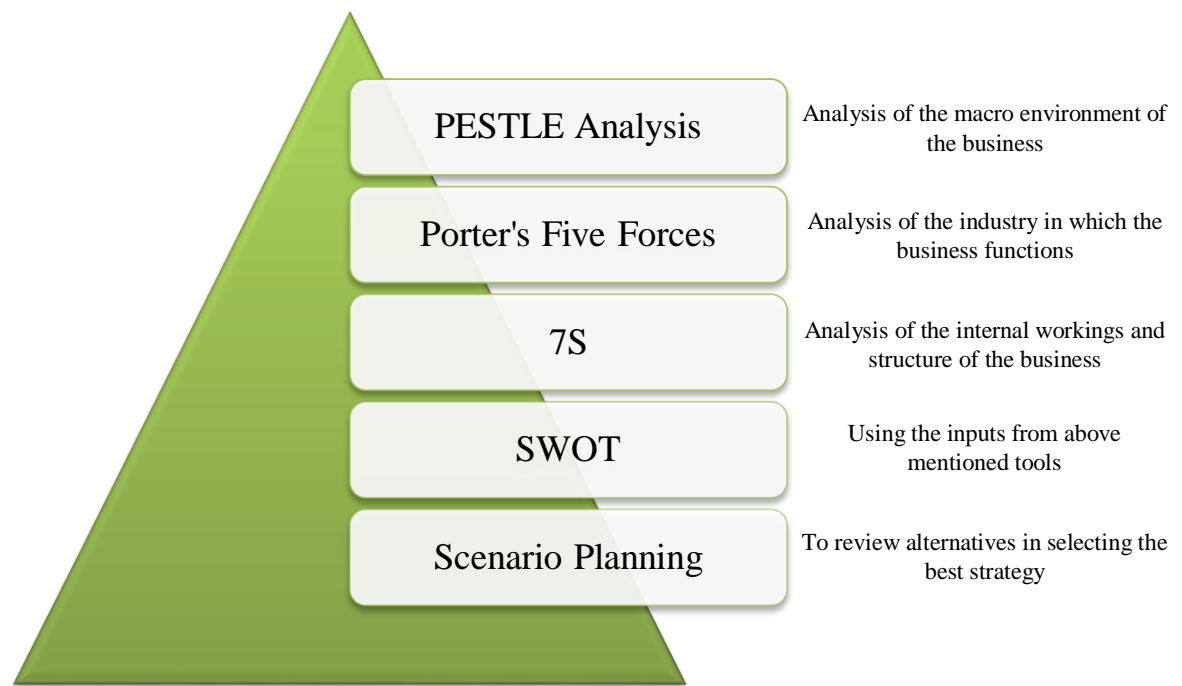
Figure 7   **Contributing strategy tools provided during the course of the Business Engineering lectures**

The methodology that will be used for the development of the requested strategy, related to the *Mobile Feeding Scheme* business engineering model, will entail the execution of each of the aspects listed in Figure 7, with the exclusion of scenario planning. Thus, the first four aspects mentioned will be addressed, due to the fact that a SWOT analysis requires the completion of each of the previous listed tools.

Figure 8 is a pictorial illustration of the process in which all the aspects mentioned within the previous paragraphs interact, in order to develop a business strategy.
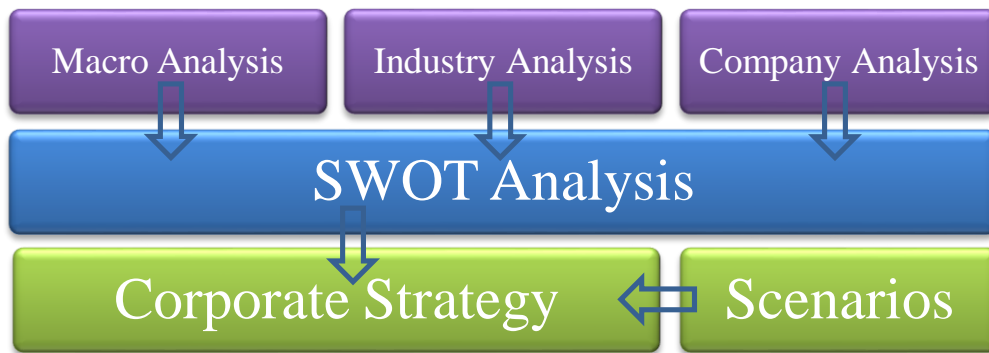
Figure 8   Pictorial illustration of developing a business strategy

1. **PESTLE Analysis**

The PESTLE analysis tool is primarily used for the analysis of an external macro-environment in which a specific organisation operates. PESTLE analysis is capable of providing management with valuable insight, when used in conjunction with Porter's Five Forces, SWOT analysis or scenario planning.

Figure 9 is a graphical representation of the PESTLE analysis tool, applicable to the development of the business strategy for the *Mobile Feeding Scheme* business engineering model project.
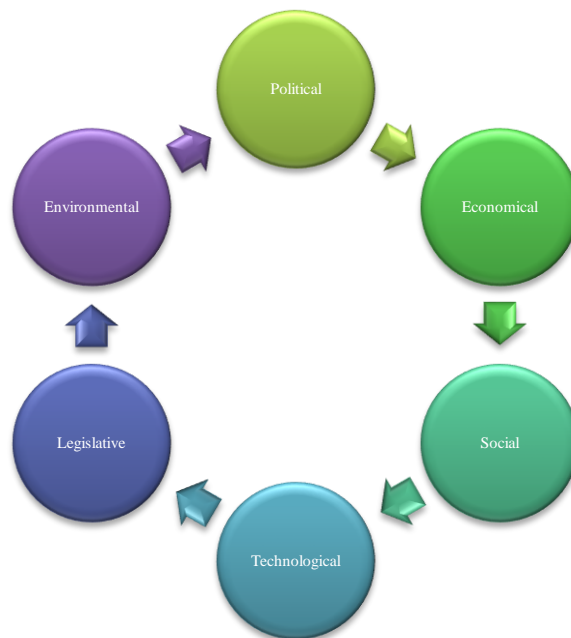
Figure 9   PESTLE Analysis

2. Porter's Five Forces

The model illustrated in Figure 10, represents the five essential forces for the development of a strategy, which was initially recognised by Porter. Rivalry among existing competitors and threat of substitutes are forces, which are focussed internally. Whilst, the remaining three forces, threat of new entrants, bargaining power of suppliers and – buyers, are focussed externally.

Figure 10 Porter's Five Forces

3. 7S Analysis

The seven-S analysis address seven specific, interdependent attributes of a business. The hard elements include skills, strategy and structure. The remaining four elements (style, staff, systems and shared values) are referred to as soft elements. A graphical representation of the seven elements can be seen in Figure 11, along with a table illustrating the practical allignment of the seven elements in Table 1.

Figure 11 7S Analysis

Table 1   Practical illustration of the alignment between the 7S elements

	Skills	Shared Values	Style	Staff	Systems	Structure	Strategy
Strategy							
Structure							
Systems							
Staff							
Style							
Shared Values							
Skills							

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4. SWOT Analysis

SWOT analysis is capable of providing insight with regard to an organisation's competitive environment, through matching resources and capabilities.

Strengths and weaknesses are recognised as internal factors (such as skills and assets), which can be measured through audits or against specific benchmarks.

Opportunities and threats are known as external factors, which primarily emerge due to changes in the macro environment (the demographic-, social-, cultural-, technological-, political- and/or legal factors). Industry specific forces (customers, suppliers, competitors and distribution channels) are capable of producing threats.

The table used for the purpose of conducting a SWOT analysis, can be viewed in Table 2. Once the strengths, weaknesses, opportunities and threats are listed and combined with a relevant point allocated to each combination based on importance, the urgent- and strategic issues can be easily identified using Table 3.

Table 2   SWOT Strategies

	Strengths (s)	Weaknesses (W)
Opportunities (O)	**SO Strategies:** Take advantage of opportunities by using strengths.	**WO Strategies:** Overcome weaknesses to take advantage of opportunities.
Treats (T)	**ST Strategies:** Avoid threats by using strengths.	**WT Strategies:** Minimise threats and avoid threats.

Table 3   Confrontation Matrix

	O1	O2	O3	O4	O5	T1	T2	T3	T4	T5	Total
S1											
S2											
S3											
S4											
S5											
W1											
W2											
W3											
W4											
W5											
Total											

2.1.5 Calculation of the Geographic Optimal Location

The geographic optimal location of a specific facility can be determined through applying the Centre of Gravity method included in the curriculum of the Industrial Engineering module titled *Facilities Planning* (BFB 320).

Equation 1   Centre of gravity x-coordinate formula

$$C_x = \frac{\sum d_{ix} V_i}{\sum V_i}$$

Equation 2   Centre of gravity y-coordinate formula

$$C_y = \frac{\sum d_{iy} V_i}{\sum V_i}$$

Steps that need to be followed, in order to sucesfully execute the Centre of Gravity method:

1. Place existing locations on map grid:

    a. $d_{ix} = x$ - coordinate of the *i*th location identified.

    b. $d_{iy} = y$ - coordinate of the *i*th location identified.

2. Establish the volume or weight moved through each point in the network:

    a. $V_i =$ volume of goods moved to and from the *i*th location.

3. Determine the centre of gravity in each axis:

    a. $C_x = x$ - coordinate of the centre of gravity.

    b. $C_y = y$ - coordinate of the centre of gravity.

The final coordinates (*x,y*) obtained as a result, will give the geographic optimal location for an intermediate facility.

2.1.6 Fact Finding Techniques

Fact finding techniques are specifically used in order to obtain a clear understanding of the relevant systems, processes or procedures to be followed. The knowledge to be gained through fact finding techniques are of utmost importance before attempting to make changes, additions or implementing any new processes, systems or procedures.

The three fact finding methods that will be used, during the duration of the *Mobile Feeding Scheme* business engineering model project, include interviews, questionnaires and the observation of the work environment.

Each of the mentioned fact finding methods will be addressed making use of the method study technique. Method study involves the interpretation and analysis of data gathered during interviews, information obtained from external sources and observations during occasional site visits. Graphs and floor plans are often used as a technique of demonstrating essential information in a simpler manner.

1. Interviews

Interviews are scheduled, personalised sessions in which a number of questions are asked and answered by the interviewer.

Due to the fact that the final project report might be published, the relevant student had to obtain approval from the Committee for Research Ethics and Integrity in order to conduct interviews. Each interviewer has to sign an informed consent form in which he or she voluntarily gives their permission for participation in the project and state that the relevant party is aware of the fact that the results of the investigation may be used for the purpose of publication.

Interviews will be conducted with three groups of individuals. The individuals to be interviewed will serve as informants and the information obtained from each interview will contribute towards the *literature review* section of the *Mobile Feeding Scheme* business engineering model final project report.

2. Questionnaires

Questionnaires are a mean of obtaining information on a question answer basis. The questionnaires are set in advance and completed by the targeted group of informants. Although the answers of questionnaires are limited, the responses are provided in the form of a hard copy.

Approval from the Committee for Research Ethics and Integrity had to be obtained in order to conduct a literature study through the completion of questionnaires. The parent or guardian of each pupil under the age of sixteen has to sign an informed consent form in which he or she voluntarily gives their permission, on behalf of their child attending school at Blaauwbosch Primary, for participation in the project. Signing the informed consent form, indicates that the relevant party is aware of the fact that the results of the investigation may be used for the purpose of publication.

With regard to the *Mobile Feeding Scheme* business engineering model, questionnaires will be completed by the Blaauwbosch Primary School pupils.

3. Observation of the Work Environment

Observation is a fact finding technique where the system analyst observes the manner in which operators perform their daily tasks. The study of operations within a working environment often enables an external person to immediately identify hazardous-, unproductive-, key problem areas of error or ruthless housekeeping.

2.1.7 Flow Diagram

A flow diagram can be defined as a pictorial plan of the flow of work, which is often useful when developing a new method. A flow diagram typically indicates the layout of floors and buildings, clearly demonstrating the location of specific facilities, such as temporary- and permanent storage areas, inspection stations and working points. A complete flow diagram illustrates the movement of material from the one activity to the next, by means of flow lines. The direction of flow is indicated by small arrows. Different colours, symbols and numbers (which correspond to that of the flow process chart) are used to identify each activity or represent more than one part.

2.1.8 Gantt Chart

The Gantt chart originated in the 1940s and was most probably the first project planning and control technique, developed to respond to the need of managing complex defence projects and systems. The Gantt chart simply indicates the associated times of the various identified project activities. The project activities are represented by bars that are plotted against time on the horizontal axis. The time in which an activity is actually completed, is indicated using shaded bars. Should a vertical line be drawn at a given date, all project components that are ahead or behind schedule can easily be determined at that specific point in time.

2.1.9 Mathematical Model Software

The new generation optimization software function called *Solver* in Microsoft Office Excel, will be used to solve the input quantities of the real-life *Mobile Feeding Scheme* problem. The software was specifically chosen, due to the fact that the majority of the South African population have access to Microsoft Office Excel. The mathematical model to be programmed using Microsoft Office Excel have to be solved on a regular basis, as a result of the daily fluctuation in the associated prices of fresh food products. Should the available LINGO- or VICO software be used to solve the mathematical model, it would imply that a solution for the mathematical model will only be attained if the consumer's computer has the relevant programmes installed.

The *Solver* function in Microsoft Office Excel, will enable the student to obtain an optimal solution for the stationary agricultural garden problem. The optimal solution will be included in the *Mobile Feeding Scheme* business engineering model.

2.1.10 Operation Process Chart

An operation process chart serves as an indication of the chronological sequence in which all operations, inspections, time allowances and materials are used in either a manufacturing- or business process. The chart is an illustration of the entire process from the arrival of raw materials (entrance of the components), the sub-assemblies, main assembly, to the packaging of the finished product(s). The two primary symbols used throughout the operation process chart, is a circle that denotes an operation and a square which signifies an inspection. Analysts often refer to the operation process chart as an outline process chart.

2.2 Methods Applicable

The two methods that were identified for the purpose of developing the *Mobile Feeding Scheme* business engineering model, will be discussed within the sub-sections that follow. Both the Monte Carlo simulation- and the mathematical modelling methods will contribute toward the concept development phase (phase I) of the business engineering model.

2.2.1 Monte Carlo Simulation

The Monte Carlo simulation was named after the city in Monaco that was famous for its casino. The numerous games within a casino can be categorised as games of chance, which involves repetitive events with known probabilities. The application of modern Monte Carlo simulation principles and methods date from the 1940s, when the atomic bomb was developed. Stanislaw Ulam, a mathematician, can be credited for his work related to the feasible execution of Monte Carlo simulation models of complex systems on computers.

According to the sited reference for Probabilistic Simulation, Monte Carlo simulation can be "*used to describe any technique that approximates solutions to quantitative problems through statistical sampling.*" [GOLDSIM, 2014]. Monte Carlo simulation can be regarded as the most coming method used to propagate the uncertainty in various aspects of an identified system, to predict performance.

The inputs of the Monte Carlo simulation can be specified as probability distributions when the process is used to explicitly represent uncertainties. Thus, the predicted outcomes that is obtained with regard to future performance, using Monte Carlo simulation, will denote a quantified probability with a probability distribution.

The time frame used for Monte Carlo simulation is referred to as the realization of a system and is quite extensive. All uncertain parameters of the system are sampled for each realization, where after the information obtained is simulated through time. This enables the user to compute the performance of the system as outputs, in the form of probability distributions.

2.2.2 Mathematical Modelling

Linear programming was primarily developed to solve complex planning problems concerning war operations in the nineteen forties. A rapid increase in demand was noticed in the post-war period. George B. Dantzig and John von Neumann are generally regarded as the founders of the subject, who devised the simple method in 1947 and established the theory of duality within that same year, respectively. The Nobel Prize was awarded to the mathematician Leonid Kantorovich and the economist Tjalling Koopmans in the year 1975, for their contribution with regard to the theory of the optimal allocation of resources, in which linear programming was considered as one of the key features.

Mathematical models are primarily used in natural- and social sciences, as well as number of engineering disciplines. Mathematical models can be regarded as abstract models in which a mathematical language is used to describe the behaviour of complete systems.

Dynamic systems, differential equations, statistical models and game theoretic models are only a number of models that can by simulated using mathematical modelling.

Six basic groups of distinctive variables are recognised in mathematical modelling:

1. Decision variables
2. Input variables
3. State variables
4. Exogenous variables
5. Random variables
6. Output variables

The variables within a mathematical model, are generally represented by vectors. Furthermore, mathematical modelling problems are commonly classified into two model types, referred to as either a white- or black box-model, depending on the information given at an initial stage. A white-box model, which is also known as a glass-box- or clear-box model, will typically represent a system where all model related information is given. A black-box model on the other hand, has no information given prior to the construction of the mathematical model.

Regarding the *Mobile Feeding Scheme* business engineering model project, a mathematical model will be formulated using applicable knowledge and techniques learned within the Industrial Engineering curriculum module, titled *Operations Research* (BOZ 312). The prescribed new generation optimization software function *Solver* in Microsoft Office Excel, will be used to solve the mathematical input quantities of the real-life *Mobile Feeding Scheme* problem.

2.3   Data Collection

The data collection section of the *Mobile Feeding Scheme* business engineering model project, includes a summary of all the books, records, articles, webpages and narratives that were consulted during the development of the business engineering model.

For the purpose of ease, the information that were obtained with regard to the *Mobile Feeding Scheme* project was divided into *three* groups, each representing the relevant phases in which the project will be executed.

The first phase (phase I) is the concept development of the *Mobile Feeding Scheme* business engineering model. The second phase (phase II) entails all aspects related to the engineering development of the mobile kitchen unit and finally, the third phase (phase III) involves the post development of the business engineering model.

2.3.1   Phase I – Concept Development

1.   Business models

A business model can be regarded as a simplified working illustration, which includes all details related to the operations within a specific business. The components of a business model typically address the functions defined within a business, such as operating strategies (business operations), organisational structures, sales and marketing procedures, forecasts, revenues and expenses (including labour cost). Therefore, a business model can be summarised as a comprehensive business plan representing the day-to-day functionality of a single business.

The internal factors related to the ongoing operations of a business, require the distinction of departments and divisions within a company. Furthermore, the procedure in which positions are identified within each department and their respective job responsibilities, can also be regarded as internal contributing factors of a business model.

It is of utmost importance to keep in mind that the customer targeted with the specific goods- or services provided by the respective company, is the primary external factor that need to be considered when developing a comprehensive business model. The mentioned aspect will influence the marketing and sales orientated efforts of the company, in addition to the function of marketing and sales within the company. Marketing and sales will indirectly impact the overall unit cost of production. Thus, a business model need to take all related information into consideration, in order to establish an adequate retail price that will enable the relevant company to operate at a profit. The figures related to forecasted calculations do however need to be based on a certain level of sales, which is consistent.

For the purpose of the *Mobile Feeding Scheme* business engineering model project, a comprehensive business model will be developed in order to enable sustainable operations that are focussed on a single, core mission. Periodic reviews and updates will be considered to ensure that the model is relevant and adaptable to change within the economic climate and variable consumer demands.

2. The South African population

The South African population section of the *Mobile Feeding Scheme* business engineering model, includes a number of sub-sections in which the unemployment rate of the South African population is conveyed, the published South African HIV and AIDS population figures are discussed and finally, a numerical value reflecting the percentage of double orphans incorporated in the South African population, is revealed.

During the year 2013, the total population of South Africa was reported to be 52.98 million by Statistics South Africa. This record is known to be an all-time maximum. In the year 1960, a total of 17.40 million people in South Africa were recorded, which imply that the total population increased with two hundred and four (204) percent over the last fifty three (53) years.

The total South African population represents 0.73 percent of the population recorded all over the world, which implies that one out of every one hundred and thirty eight (138) people on planet Earth, is a South African resident.
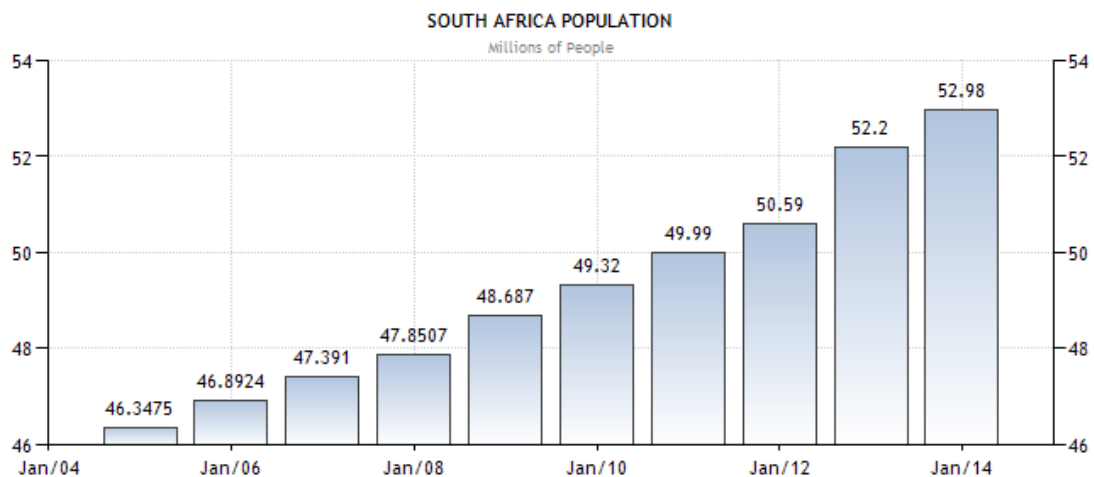
Source: Statistics South Africa (2013).

Figure 12 Graphical representation of the South African population (in millions) for the past 10 years

Figure 12 is a graphical representation, clearly illustrating the growth of the South African population for the past ten (10) years (from the year 2004 until the year 2014).

The student intends to use the historical data obtained from Statistics South Africa, to make a forecast with regard to the South African population for the years to come. The results obtained from the forecasted model, will be used to motivate the implementation of the *Mobile Feeding Scheme* business engineering model.

2.1 The unemployment rate of the South African population

Statistics South Africa reported the following figures related to unemployment within South Africa: an unemployment rate of 24.10 percent was recorded on the 31st of December 2013. Previously, a forecasted rate of 24.50 percent on the 31st of March 2013 was noted of which the highest recording up to date is 31.20 percent and the lowest 21.50 percent. The forecasted unemployment figure for the 31st of March 2014 was 24.20 percent. The relevant dates indicated, are approximately one year apart with a forecasted decrease of 0.30 percent.

The student shall make use of the current unemployment rate in South Africa, to indicate the demand for a feeding scheme orientated project within South Africa.

2.2 The published South African HIV and AIDS population figures

Statistics representing the number of reported deaths and their respective causes according to the associated death notification forms, were published by Statistics South Africa during the month of April in the year 2013.

The published report, titled 'Mortality and cases of death in South Africa, 2010' reveals a dramatic incline of ninety three (93) percent in the number of annual deaths between the time interval of 1997 and 2006, and an increase of eleven (11) percent for the time interval of 2006 and 2010. Possible contributing factors might entail the significant increase in the South African population growth of two hundred and four (204) percent during the past fifty three (53) years, although the increase in population could not entirely take all the blame for the extreme upsurge in deaths. The statistics indicated that the noted deaths are specifically among people between the age of twenty five (25) and fourty nine (49) years.

The following table (Table 4), is a representation of the deaths caused by HIV and AIDS related diseases. Since the figures conveyed within the tabular format represents the number of death notification forms with an unspecified description, the data may contain a certain degree of error.

Table 4   Statistics representing the South African HIV and AIDS related figures

Year of death	Age (years)					Total
	0-9	10-24	25-49	50+	Unspecified	
1997	35,459	22,698	93,159	160,239	5,577	317,132
1998	41,183	25,873	114,711	178,979	5,107	365,853
1999	41,859	27,766	130,415	179,072	2,708	381,820
2000	42,873	29,761	151,374	189,930	2,217	416,155
2001	44,947	31,586	174,066	202,359	1,924	454,882
2002	50,844	34,593	202,359	212,217	2,037	502,050
2003	56,879	37,712	230,925	228,459	2,804	556,779
2004	63,350	38,720	246,259	225,290	3,090	576,709
2005	68,206	38,791	253,262	234,595	3,277	598,131
2006	69,912	39,526	253,923	248,053	1,364	612,778
2007	66,898	37,869	245,754	251,351	1,222	603,094
2008	65,646	36,504	237,036	251,919	968	592,073
2009	54,784	34,528	221,524	260,548	1,289	572,673
2010	51,990	32,699	203,284	254,732	1,151	543,856
2009-2010 difference	-5.1%	-5.3%	-8.2%	-2.2%	-	-5%

The final year student intends to use the South African HIV and AIDS related figures stated above, to forecast the annual increasing demand for feeding schemes in South Africa due to the increased number of children growing up in homes without parents or guardians. The relevant children will directly benefit from the implementation of a feeding scheme, such as the proposed *Mobile Feeding Scheme*.

2.3 The percentage of double orphans incorporated in the South African population

Research relating to the number of South African children living without either one- or both parents, were conducted in order to establish a measurement of demand. In the case where a single parent receives a minor income per month, the relevant child, or in several cases numerous children, will surely benefit from the implementation of a feeding scheme at the local schools within the community. Similarly, would a child without any parents.

The definition of an orphan can be stated as a child under the age of eighteen years without a single biological parent (mother or father), or both biological parents. The terminology *without* used within the previous sentence, includes whether the relevant parents are deceased or their statuses are reported as unknown. Orphans can thus be categorised in three mutually exclusive categories, namely: maternal- (motherless), paternal- (fatherless) or double orphan (mother- and fatherless).

Thus, the total number of orphans represent the sum of all maternal-, paternal- and double orphans. This calculation do however differ from that of the Actuarial Society of South Africa (ASSA).

In the year 2011, approximately 3.85 million orphans were recorded within South Africa, which is the equivalent of twenty one (21) percent of children in South Africa. The associated figures indicate an increase of 853 000 children from the year 2002 until 2011, representing a twenty eight (28) percent increase over that same period of time.

Furthermore, research showed that maternal orphans are seemingly more at risk of poorer circumstances than paternal orphans, due to lower income incurred by the mother figures. The chances of proper education are often very little.

Figure 13 is a graphical representation of all the double orphanhood associated figures, for each of nine South African provinces - for the period of 2002 until 2011.
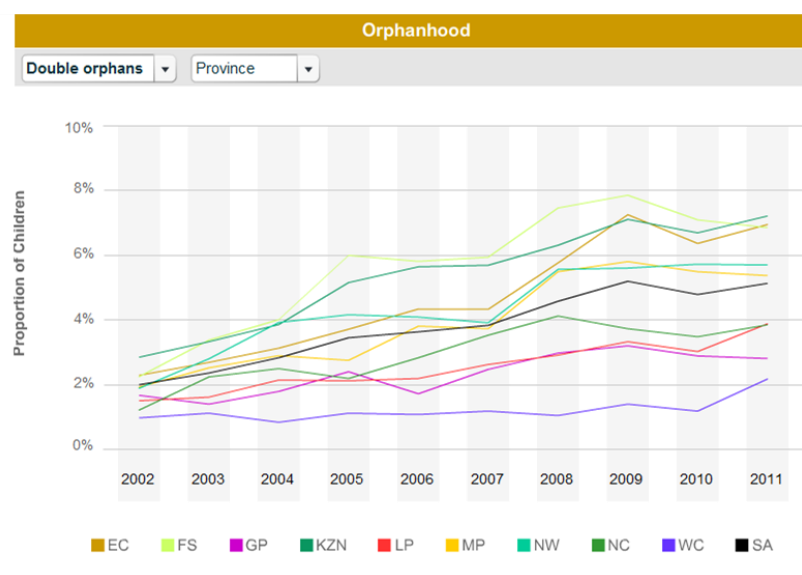
Source: Statistics South Africa (2011).

Figure 13 Figures related to double orphanhood in South Africa for 2002 until 2011

3. The South African population division

Research related to the division of the South African population was conducted. The relevant student obtained results indicating that the provinces of Gauteng and KwaZulu Natal account for fourty two (42) percent of the total South African population, each carrying a weight of 23.7 percent and 19.8 percent respectively. The two leading populated provinces are followed by the Eastern Cape with 12.7 percent, the Western Cape with 11.3 percent, Limpopo with 10.4 percent, Mpumalanga with 7.8 percent, North West with 6.8 percent, the Free State with 5.3 percent and lastly, the Northern Cape with 2.2 percent.

When comparing census data over a period of time, a decline of 2.4 percent in the total provincial population of the Eastern Cape can be observed, for the time interval of 1996 until 2011. The Western Cape can be concluded as the fastest growing province, with a total provincial population growth of twenty nine (29) percent within a five year interval commencing in 2006. The total provincial population of Gauteng indicated a growth of thirty one (31) percent over the past decade. Data revealed that an approximate percentage of fifty six (56) percent, of the total provincial population of Gauteng were born in the particular province. Lastly, a definite flow of people from rural- to urban areas can be noticed.

Table 5 below, is a representation of the South African population division arranged in alphabetical order. The relevant data were published by Statistics South Africa in the year 2011.

Table 5   Statistics representing the South African population division by province

Population by Province (2011)		
Province	**Population**	**% of Total Population**
Eastern Cape	6 562 053	12.7%
Free State	2 745 590	5.3%
Gauteng	12 272 263	23.7%
KwaZulu Natal	10 267 300	19.8%
Limpopo	5 404 868	10.4%
Mpumalanga	4 039 939	7.8%
Northern Cape	1 145 861	2.2%
North West	3 509 953	6.8%
Western Cape	5 822 734	11.3%
TOTAL	**51 770 560**	**100%**

During the year 2013 Statistics South Africa reported the total population of South Africa to be 49.99 million for the year 2011, compared to the stated 51.77 million in the census conducted in 2011. It implies that the data tabulated in Table 5 contains a certain degree of error, although the results obtained are still relevant and applicable to the *Mobile Feeding Scheme* project.

The researched division of the South African population was used to determine the highest populated provinces, within South Africa. The results will be used to identify the areas of greatest demand, in order to motivate the specific area of implementation for the first iteration of the *Mobile Feeding Scheme* business engineering model.

4. Areas of highest demand for supportive projects in South Africa

Previous conducted research figures, published by Statistics South Africa, indicated that the provinces of Gauteng and KwaZulu Natal respectively account for 23.7 - and 19.8 percent of the total South African population.

Although the population division was already stated in the previous sub-section titled *the South African population division*, an in depth investigation with regard to area specific population densities were executed. The investigation will enable the student to distinguish the population distribution within each of the nine South African provinces.

During the period in which the student conducted the in depth population density research, a map clearly demonstrating the South African area specific population density was obtained. The map indicated in Figure 14 was initially generated by the Centre for International Earth Science Information Network in Columbia, which was thereafter published by Statistics South Africa in the year 2010.
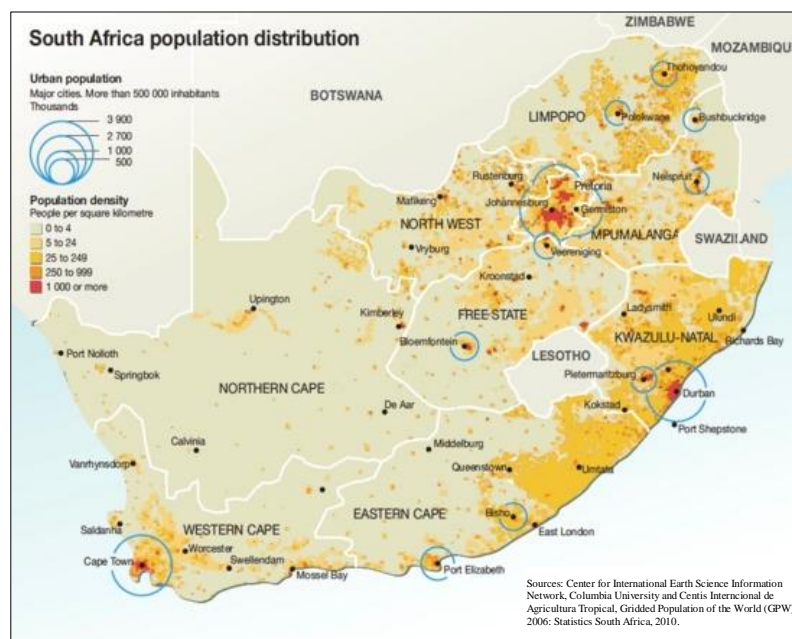
Source: Statistics South Africa (2010).

Figure 14 Map serving as a graphical representation of the South African population distribution

From the information obtained within the previous sub-section of the final project report, it is clear that the Northern Cape province is the largest province covering approximately one third of the total South African land surface, with the smallest population figure of only 1.15 million people (2.2 percent of the total South African population).

The map in Figure 14 undoubtedly specifies the area specific population of highest demand, making use of different colours. All the areas within the South African border with a population density of one thousand people or more, per square kilometre (1 000/km^2), is indicated in red.

The focus, with regard to the possible implementation of the *Mobile Feeding Scheme* business engineering model supportive project, will most definitely be within the identified areas of high demand.

The three individuals who initiated the *Mobile Feeding Scheme* project on behalf of the Blaauwbosch Primary School pupils, are stationed in one of the areas of high demand - indicated in red on the map displayed in Figure 14. The Blaauwbosch Primary School is situated in Northern KwaZulu Natal, within the Osizweni community that is part of the Newcastle municipal area.

5. Schools situated within the narrowed area identified for its demand

As previously mentioned in the *introduction* section of the final project report, the three voluntary individuals currently managing the government subsidized feeding scheme at the Blaauwbosch Primary School requested a mobile kitchen. The request initiated the development of the *Mobile Feeding Scheme* business engineering model project, which will be implemented at the Blaauwbosch Primary School as a first iteration, in order to test the validity of the model.

This would imply that the data collected with regard to the schools situated within the narrowed area identified for its demand, will specifically be applicable to Blaauwbosch Primary School and nearby situated schools in the Osizweni community. The communities of both Madadeni and Osizweni are part of the Newcastle municipal area in Northern KwaZulu Natal.

The schools listed within the identified area of demand, including Blaauwbosch Primary School, are listed as Newcastle District schools. Table 26, which can be viewed in Appendix G, was compiled during the period in which the student conducted research with regard to schools listed as Newcastle District schools. A total number of one hundred and fifty five (155) schools are currently listed as Newcastle District schools.

Figure 15 is a map obtained using School Maps Online, indicating all relevant schools, education centres, hospitals, clinics and police stations located within the Madadeni and Osizweni communities.

Source: School Maps Online (2014).

Figure 15   Pictographic representation of the Madadeni and Osizweni region

The research related to the schools situated within the narrowed area identified for its demand, will be used to indicate the numerous possibilities for the implementation of the *Mobile Feeding Scheme* business engineering project within the same region, in addition to the identification of schools situated within the area of Blaauwbosch Primary School.

6. Review of past reported work

The review of past reported work sub-section included in the final project report, provides feedback related to the government National School Nutrition Programme, the success of the Shoprite Feeding Scheme, food provided to a number of communities with the help of the African Children's Feeding Scheme and lastly, the impact of the Art of Living Foundation feeding scheme.

The research conveyed within this particular sub-section, will serve as a guideline for the development of the *Mobile Feeding Scheme* business engineering model.

6.1 National School Nutrition Programme

Earlier this year the Mercury published an article written by Leanne Jansen, with the heading 'Department tackles school feeding scheme'. The relevant article stated that the Department of Education made a concluding decision regarding the school feeding scheme executed at a number of underprivileged schools, situated in the province of KwaZulu Natal. A project management firm has been contacted with the purpose of resolving all obstacle related problems, preventing the successful implementation of the billion-rand project.

The portfolio committee of education was informed that the previous difficulties affected the pupils of one hundred and seventeen (117) schools, of the five thousand two hundred and seventy five schools (5 275), that are depending on the National School Nutrition Programme. The relevant pupils of the one hundred and seventeen (117) schools did not receive any food for a number of days.

Figure 16 Pupils receiving food as part of the National School Nutrition Programme

According to a report, which was handed over to the KwaZulu Natal legislature, this specific problem was primarily caused by food that was not delivered at the relevant schools on time. Furthermore, the late delivery was insufficient due to shortages and in some cases, the food delivered was not included on the departmental menu.

Finally, the article stated that the primary school pupils are provided with soya mince, pilchards (twice a week), one serving of vegetables on a daily basis and fruit - approximately once a month. It is reported that no milk is included in the menu.

6.2 Shoprite mobile soup kitchen

A feeding scheme was launched approximately five years ago, by the famous South African retailer Shoprite. Companies within the automotive industry, such as Toyota, Volkswagen and Mercedes, also support this initiative. According to Shoprite's CEO, Whitey Basson, the primary objective of the implemented programme is to help the poor communities in South Africa that are under tremendous pressure due to the current economic climate.

The original planning for the feeding scheme involved the distribution of 3.88 million cups of soup for children, senior citizens and the thousands of people who are unemployed as a result of retrenchment. Two mobile soup kitchens were initially deployed in the Gauteng and North West provinces. Future expansion included the implementation of two mobile soup kitchens in each of the following provinces: KwaZulu Natal and Western Cape. Furthermore, a single mobile soup kitchen was deployed in each of the following provinces: Eastern Cape, Free State, Limpopo, Mpumalanga and Northern Cape.

Figure 17 Picture illustrating the impact of the Shoprite mobile soup kitchen

6.3 African Children's Feeding Scheme (ACFS)

The African Children's Feeding Scheme (ACFS) was originally developed in 1945 by Bishop Trevor Huddleston, who provided school children with peanut butter sandwiches. Decades thereafter, people are following in his footsteps providing communities in Alexandra, Daveyton, Kagiso, Kwa Thema, Soweto, Thembisa and Tsakane with sandwiches and milk on a daily basis. The ACFS are currently providing sandwiches and milk to approximately 3 150 children.

6.4 Art of Living Foundation feeding scheme

An article in the Sunday Star that was published early in the year of 2012, testified the impact of a school feeding scheme on a single pupil. The relevant pupil, Albert Dove, matriculated with six distinctions at the Fonte High School in Dobsonville, situated in Soweto.

During the interview with the Sunday Star, Albert Dove, gave the credit for his outstanding achievement to the school's feeding scheme. The Art of Living Foundation, is responsible for the feeding scheme at the mentioned school and they were sustaining one hundred (100) to three hundred (300) pupils at that point in time. The pupil informed the reporter that the feeding scheme indirectly motivated him to attend extra classes in both maths and science during weekends. The perfect score of one hundred (100) percent in physical science on a matric level, served as proof of his hard work and dedication.

The Art of Living Foundation is proud to report that all eight matriculants, who received assistance from the school feeding scheme during that same year, have succeeded in their final year of school.

Figure 18 A photo of the outstanding pupil who was interviewed by the Sunday Star, Albert Dove

7. The impact of receiving no food on a scholar

The effects of eating no food, whether it is because of a lack of access, fasting or self-imposed starvation, or due to an eating disorder, have a direct negative impact on both the physical and mental capabilities of the human body. When the human body is withhold from the intake of food, the body starts to break down fat in order to transform the fat into energy. Once all the fat within the human body is broken down, vital tissues, muscles and internal organs are broken down which could cause serious complications and possible death.

When considering the human body and the impact of receiving no food, three primary areas can be addressed namely the physical influence, cognitive effect and the impact on sociability.

The physical growth and development of the human body, specifically referring to the bodies of children, can be directly linked to good nutrition. Research proved that children who are experiencing chronic hunger are at risk of not reaching the necessary developmental milestones, due to a lack of essential vitamins and minerals. Physical effects include: shorter than the average height and children who are significantly underweight. Furthermore, hunger causes lower immunity levels, which increase the risk of childhood diseases and influence the overall physical health.

The cognitive function of the human body is definitely influenced by starvation. Children often struggle to focus when in an academic environment, which is primarily caused by a lack of motivation and energy. The development of cognitive impairments or learning disabilities is a reality and the fact that children who are hungry often have ongoing health issues, could imply frequent absence. All of the above mentioned issues, regularly cause hungry children to fall behind at school level.

Children who are experiencing hunger first hand often feel ashamed and embarrassed, which are factors that could have a direct impact on the interaction of a child among a group of family or friends. Academic difficulty often contribute to the social isolation of individuals, since he or she may be older than the majority of the group of classmates. The worst case scenario would entail negative interactions among hungry children who end up fighting or stealing to survive. Lastly, it can be noticed that children suffering from chronicle hunger, usually indicate unfamiliar signs of stress and anxiety.

8. Food preferences

The food preferences of the grade six and seven pupils attending school at Blaauwbosch Primary School, were researched using questionnaires. The University of Pretoria Committee for Research Ethics and Integrity approved both the questionnaire and the accompanied letter of consent, which were compiled during the initial stages of the *Mobile Feeding Scheme* business engineering model project.

The letter of approval from the Committee for Research Ethics and Integrity, the letter of consent (informed consent form for questionnaires) and a sample of the questionnaire that was completed, are included in Appendix D, Appendix E and Appendix F of the final project report, respectively.

9. Balanced diets and food nutritions

Research revealed that eating healthy is much easier than most people believe it to be. In the case where a diet is based on:

- starchy food (potatoes, rice and pasta),
- plenty of vegetables and fruit,
- protein rich food (meat, fish and lentils),
- milk and dairy products
- and a limited consumption of fat, salt and sugar,

it can be concluded that the relevant diet provides the consumer with all the necessary nutrients needed.

According to researched sources a balanced diet implies consuming the right amount (calorie requirements) of food and beverages to maintain a healthy body weight, on a daily basis. This will however entail eating the right proportions of a wide variety of food groups. The nutritional calorie requirements of each individual can differ, depending on the sex, age, height and lastly, the overall health and weight of the consumer.

It is said that the implementation of a balanced diet plan could resolve a number of health associated problems, caused by the fast world we live in and the high volumes of stress people are exposed to.

The eat well plate, illustrated in Figure 19, was obtained during the period in which the student conducted research. The associated proportions of each food group is clearly demonstrated by the picture of the eat well plate, below. The illustration is applicable to most people, no matter what their ethnic origin might entail. It is important to note that the eat well plate excludes children under the age of two years and recommends that a person with special, prescribed dietary requirements or medical needs have to consult a registered dietitian to confirm whether or not the eat well plate is applicable to them.

Source: NHS CHOICES (2014).
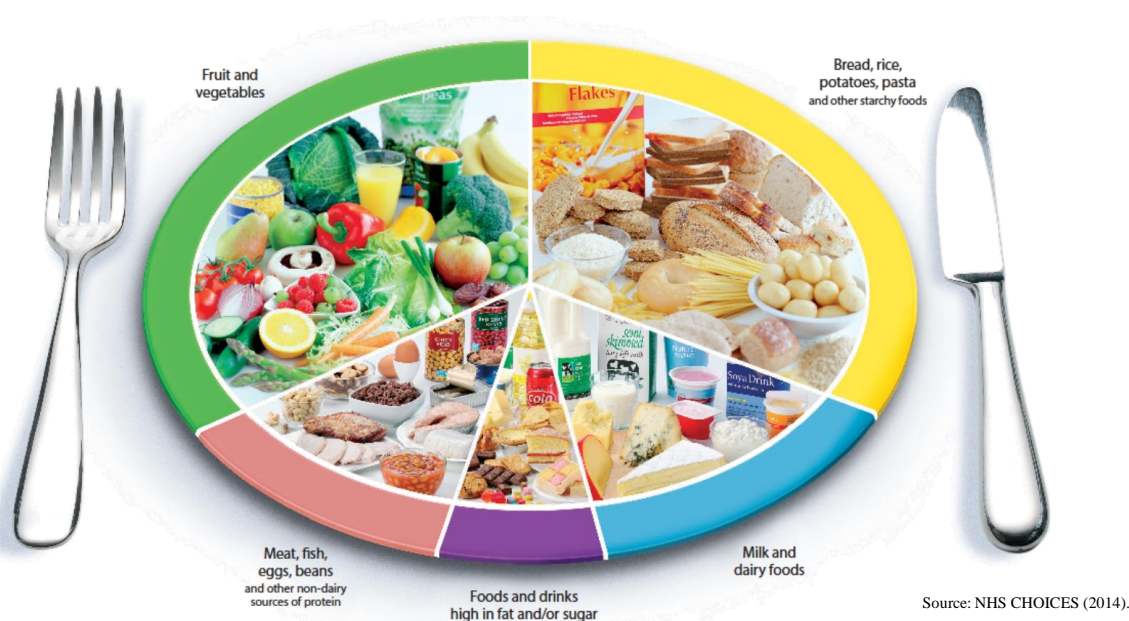
Figure 19 A pictorial representation of the eat well plate

For the purpose of the *Mobile Feeding Scheme* business engineering model project, the student examined two diets that are appropriate for the development of children. The first diet, tabulated in Table 6, indicates the number of servings of each food type that need to be consumed on a daily basis. The other, revealed in Table 7, is a sample of a balanced toddler menu. Both of the diets applicable to children will be used as guidelines for the design of the balanced diet, to be incorporated within the business engineering model (phase I). The balanced toddler menu includes all necessary vitamins, minerals, proteins and carbohydrates to keep the toddlers' bodies healthy and fit.

Table 6   Diet indicating daily servings for children

Food Type	Examples of Food Items	Serving	Serving per Day
Dairy Products	milk yoghurt cheese	- 200 ml - 150 g - 40 g	2 - 4 serves per day
Fruits	apple banana sweet lime	1 glass of juice OR 1 piece	2 - 3 serves per day
Vegetables	broccoli cabbage salad spinach	150 g	3 - 4 serves per day
Proteins	chicken fish meat dried beans eggs lentils	1 piece OR $\frac{3}{4}$ cup of cooked beans or lentils	1 - 2 serves per day
Whole Grain Food	cereal bread pasta: (cooked rice or noodles)	- 1 cup - 2 sliced - 1 cup	4 - 5 serves per day

Table 7   Sample of a balanced toddler menu obtained through research

Breakfast	Calories	Requirements Tally
½ slice whole wheat toast	64	½ ounce grains met
1 teaspoon butter	31	1 teaspoon fats met
¼ cup diced pears	24	¼ cup fruit met
½ cup whole milk	73	½ cup milk met

Morning Snack	Calories	Requirements Tally
5 whole wheat crackers	89	1 ½ ounce grains met
¼ cup diced peaches	18	½ cup fruit met

Lunch	Calories	Requirements Tally
1 slice whole wheat bread	128	2 ½ ounces grains met
1 slice Swiss cheese	160	1 ½ cup milk met
1 slice ham	37	1 ounce meat met
1 teaspoon butter	31	2 teaspoons fats met
½ cup steamed broccoli	27	½ cup vegetables met

Afternoon Snack	Calories	Requirements Tally
¼ cup ricotta cheese	107	2 cups milk met
¼ cup crushed pineapple	37	¾ cup fruit met

Dinner	Calories	Requirements Tally
½ cup green peppers and carrots for stir fry	23	1 cup vegetables met
1 ounce chicken breast	31	2 ounces meat met
¼ cup brown rice	54	3 ounces grains met
1 teaspoon canola oil	40	3 teaspoons fats met
¼ cup watermelon balls	12	1 cup fruit met

Total Calories   **986** $\Longrightarrow$ **all** nutritional requirements are met

10. Facilities planning and lean manufacturing

Facilities planning is of utmost importance, when considering a facility from the perspective of an Industrial Engineer. The primary objective of a thorough planned facility is to realise the ideal process flow of equipment and products, increase the overall throughput rate and conduct operations within a safe and ergonomic environment.

During the time in which the student conducted research related to facilities planning, the student obtained an article titled: *Facilities in Lean Manufacturing Strategy*. The literature stated that facilities are expensive, often take years to commission and therefore the same facilities are used for decades even when flaws were identified at an initial stage of operations. Facilities are without a doubt regarded as one of the most important strategic elements of a business enterprise. Thus, the planning phase, which entails the strategic thinking, preceding the design of the relevant facilities need to be thoroughly executed.

The Toyota Production System (TPS), which was developed by the Toyota Motor Corporation after the oil embargo in 1973, is known as one of the leaders when it comes to lean manufacturing. Lean manufacturing primarily entails adding value through increasing efficiency and cutting or avoiding waste, which decreases costs. In the United States of America the TPS approach are referred to as lean manufacturing.

Background regarding TPS, includes the seven types of muda or waste that can be listed as follows:

1. Overproduction
2. Waiting for the next step
3. Unnecessary transportation
4. Over processing
5. Excess inventory
6. Unnecessary motion
7. Defective products

Facilities planning, includes all planning related to the land, buildings, equipment and furnishings that add value and provides physical capability. Layout and material handling issues within a business environment can usually be directly traced to inappropriate business architecture.

Examples of *key manufacturing tasks* that need to be considered when designing the layout of a plant, can be listed as follow:

- Low cost operations
- Provide fast delivery
- Enable frequent new products
- Production of a variety of products
- Production of high or low volume products
- Production of the highest level of quality
- Unique services or features to be provided

Should the key manufacturing tasks be considered when designing the layout of a specific plant, it can be regarded as a source of competitive advantage.

Trade-offs often have to be made, when designing a facility. The company policy could indicate that performance have to be optimised on specific dimensions, which would imply that performance be sacrificed in other areas, due to technical limitations. The ideal scenario would be to minimise the area in which performance is sacrificed.

A lean facility can be described as a facility which is specifically design to adhere to lean manufacturing strategies.

For the purpose of the *Mobile Feeding Scheme* project, the student will primarily address the re-design of facilities. The reason for considering the re-design of existing structures is mainly due to the fact that schools often have empty buildings or classrooms available to locate the respective *Mobile Feeding Scheme* stationary kitchen.

When referring to the re-design of a layout, catalysts often refer to the re-structuring of the layout. For the duration of the project, the student will thus refer to re-design as re-structuring.

A properly executed layout project can demonstrate the area(s) of essence, which is subject to change when the opportunity should be given for rebuild. Features or characteristics that distinguish facility designs from one another include product focused work cells, focussed plant-within-plant units, the reduction of storage and handling space, Kanban stock point and the direct delivery of materials to the point of use.

According to the article written on *Facilities in Lean Manufacturing Strategy*, there are four fundamental elements to consider when designing or re-structuring any layout:

1. Space planning units (SPUs, activity areas)
2. Affinities (relationships)
3. Space
4. Constraints

The space planning units, in combination with affinities, are used to form an affinity diagram. The affinity diagram is a representation of an idealized spatial arrangement which is ultimately transformed into a layout. Once the space planning units are allocated to the affinity diagram, a primitive layout can be obtained. The constraints include all assumptions, conditions, policies or edicts made, that could restrict the facility design. The addition of the constraints is the final step in which the spatial arrangement is updated, which results in a Macro layout of the facility.

Figure 20 is a graphical representation of the combination of fundamental elements, described in the previous paragraph.
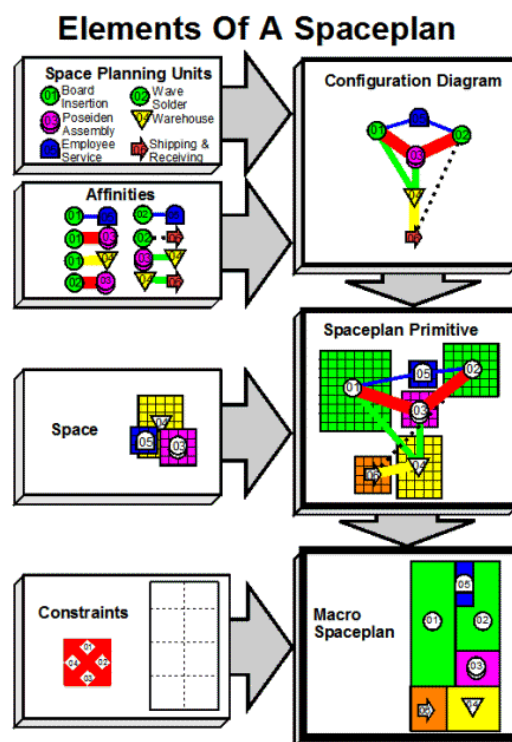
Figure 20 Fundamental elements combination for the purpose of facilities planning

Finally, it is important to note that the fundamental layout elements and their variations previously mentioned, are applicable to any facility size.

11. Stationary agricultural garden layout

The stationary agricultural garden referred to for the duration of the *Mobile Feeding Scheme* business engineering model project, entails the development of a vegetable garden that is ideally planned to assure easy maintenance, increased yields and promises to utilise space efficiently. The design of the stationary agricultural garden will be directly linked to the mathematical model generated within phase I of the final project report.

It is of utmost importance to: plan sufficient aisle space so that all the plants within the vegetable garden are easily accessible, make provision for both sun- and shade plants, in addition to companion planting and plant rotation, when designing a vegetable garden. Research revealed that there are no rules when it comes to the layout of a vegetable garden, although there are some tried and true methods that can be applied.

The organisation of rows and beds within a vegetable garden enables the consumer to maximise yields.

Vegetable gardens are usually laid out in rows and beds. The rows can either be single rows or wide rows. Single rows can be regarded as practical, due to the fact that is enables easy access and harvesting. Traditionally, single rows were used in larger vegetable gardens with crops such as carrots, celery, onions and lettuce. On the other hand wide rows are preferred for companion planting and when planting broadcast seeding. Broadcast seeding implies that the seeding is spread across the row and is specifically used for bush beans, cabbages, peppers and herbs. Raised beds or small hills can be used within the rows.

The rows within a vegetable garden can either be beds that are flat, raised or boxed using rigid enclosures, such as wooden frames, a fixed structure made with concrete and bricks, or decorative stones that are strategically placed around the vegetable garden. Figure 21 illustrates a raised bed enclosed with wooden planks. Raised beds are often preferred for several reasons:

- The soil warms quicker, which implies that the crop can be planted earlier in the season.

- The soil remains warmer over a longer period of time ensuring earlier maturity among the crop.

- Furthermore, this method provides better drainage.

In the case where the rows of vegetable gardens are raised and boxed, it is important to note that the soil should be an estimated eight to twelve inches above the ground level. Research showed that raised beds are ideal for circumstances were the conditions of the soil are less than perfect and a variety of vegetables requiring varying soil needs, need to be facilitated.

Figure 21 Vegetable garden beds that are boxed using wooden planks

The square foot method is often used for smaller garden spaces dedicated to vegetable gardening. The method implies that the total available space is divided into square foot sections. Each section is planted with broadcast seeding of a particular vegetable. Once again boxed beds, raised beds or flat soil planting can be used.

A mixture of single row-, wide row planting or square foot sections can be used, depending on the size of the vegetable garden available.

It is known that the various vegetable plants require different soil and fertiliser, the watering requirements of the various vegetable plants vary and that the season in which each vegetable plant grows is unique. Thus, the optimal layout of a vegetable garden would entail that the beds are arranged in such a manner to accommodate the differing needs.

An important concept to keep in mind for the functional design of a vegetable garden layout involves rows that run from north to south, in order to ensure air circulation and optimal sun exposure.

The tall crops (beans, peas and corn) should be planted in the southern side of the vegetable garden in order to make sure that the tall crops do not shade the rest of the vegetable crops, since leaf crops are said to be the only plants that will grow in limited sun.

It is suggested that the medium sized crops (cabbage, cauliflower, broccoli, tomatoes, squash, pumpkins, etc.) are planted in the middle of the vegetable garden.

At the most northern part of the garden, the low growing crops, such as beetroots, carrots, lettuce, onions and radishes should be planted.

Due to the fact that the vegetable garden for the *Mobile Feeding Scheme* will be commercialised, it is important to consider some of the common companion plants that are known to ward off pests, such as marigold and garlic. Other pairings include basil and tomato plans, chive and carrots, rosemary with beans and lastly, horseradish with potatoes.

The method used to provide the various crops with water, is an integrated part of designing the stationary facility layout. It is important that the method decided upon watering the relevant plants is compatible with the type of rows or beds chosen. Sprinkles and/or drip systems should be installed prior to the imbedding of the respective crops.

Besides planting and picking, a vegetable garden requires additional feeding, mulch and weed. Furthermore it is of utmost importance that pests are controlled within the specific environment and certain plants need to be thinned in order to ensure optimal growth.

Plant rotation, which was previously mentioned, have to be considered when planning the layout of a vegetable garden. Thus, it is important to annually allocate a specific area of land that will be subject to rest in order for the soil to renew itself. Creating a compost heap is highly recommended in order to ensure sustainability in the long run.

The design of the stationary agricultural garden facility, with regard to the *Mobile Feeding Scheme* business engineering model, will comprise all of the aspects considered within the *stationary agricultural garden layout* sub-section of the final project report.

12. Agricultural requirements

When an initial decision has to be made concerning the types of crop to grow in a vegetable garden, the rate of consumption needs to be considered, in addition to the magnitude of land to be utilised by each crop. The ideal scenario would entail utilising the available area, dedicated for growing vegetables, to meet the demand. The decision related to the variety of crops to be planted, will partially be influenced by the vegetable types that are suitable for growth in the specific region.

For the purpose of the *Mobile Feeding Scheme* project, the types of crop to be planted will be determined by the vegetables included in the balanced diet formulated by a specialist in that particular field.

During the time in which the student conducted research with regard to the amount of vegetables that will be suitable for the *Mobile Feeding Scheme* business engineering model, two sets of data were obtained. Each of the data sets represents estimated figures for the most popular vegetables, when growing vegetables for an average family consisting out of four persons. The data can be viewed in Table 8 and Table 9, below.

Table 8   Approximate figures for a family of four when planting vegetables

Plant Type	Number of Plants	Associated Length of Row
Asparagus	30 - 40	15 to 25 feet long
Beetroots	-	10 to 15 feet long
Broccoli	10 - 15	-
Brussels	10 - 15	-
Sprouts	10 - 15	-
Cabbage	10 - 15	-
Carrots	-	20 to 30 feet long
Corn	-	20 to 30 feet long
Lettuce	-	10 to 15 feet long
Peas	-	30 to 40 feet long
Pumpkins/Squash	1 - 3	-
Radishes	-	4 feet long
Rhubarb	1 – 3	-
Spinach	-	10 to 20 feet long
Tomatoes	10 - 15	-

Table 9   Approximate seed planting figures for the consumption of four people

Plant Type	Spacing	Plants per 4 Persons	Number of Seeds Needed	Seeds/Gram
Asparagus	9" to 12"	32 plants	32	46
Bush Beans	4" to 6"	80 to 120 feet long	360	3
Beetroots	4"	60 feet long	180	37-99
Broccoli	24' to 30"	12 to 15 plants	15	174-330
Cabbage	24' to 36"	12 to 15 plants	15	99-370
Carrots	2" to 4"	40 feet long	240	385-850
Cauliflower	18" to 24"	12 to 15 plants	15	174-330
Corn	8" to 12"	140 feet long	210	5-6
Cucumbers	8" to 36"	6 to 8 plants	8	35
Kohlrabi	6" to 8"	12 to 15 feet long	30	257-330
Leaf Lettuce	12"	20 to 30 feet long	30	935
Mustard	6"	3 to 4 plants	4	462
Green Onions	1" to 2"	10 feet long	120	440
Peas	2"	120 to 160 feet long	960	3
Peppers	18" to 24"	6 to 10 plants	10	154
Pumpkins	36" to 48"	3 plants	3	6
Radishes	2"	20 feet long	120	70-160
Spinach	12"	10 to 20 feet long	20	50-150
Squash	36" to 48"	3 plants	3	10
Tomatoes	24" to 36"	10 to 15 plants	15	350
Turnips	4" to 6"	10 to 15 feet long	45	275-530

Should a comparison be made between the two tables (Table 8 and Table 9), it can be noticed that the data related to the number of plants to be planted, are similar. However, the data representing the row lengths in feet long units, often differ. The data will be reviewed by a specialist before it is included within the mathematical model, for the purpose of the *Mobile Feeding Scheme* project.

When it comes to the practical implementation of a vegetable garden, soil preparation is of utmost importance. It is necessary to add and mix substantial amounts or organic humus (compost, peat moss, well-rotted manure or processed manure available in bags), with the existing soil. Fresh manure is only recommended when applied in fall, since it is capable of burning and/or damaging crops and single fresh manure gasses can stunt crops. Should topsoil be used to enrich or add to the existing soil, it is suggested that organic humus is added.

Information relating to the type and quality of soil required for the growth of each of the above mentioned plant types in Table 8 and Table 9, data related to the essence of constructing contours within a vegetable garden that is situated along an incline, necessary fertilizers, relevant amounts of watering and the ration of error for germination to be considered, will be obtained during an interview with a specialist in that particular field. The interview will be conducted using the relevant questions, approved by the University of Pretoria Committee for Research Ethics and Integrity.

13. General industrial kitchen layouts

Dr Lillian Gilbreth was not only the mother of twelve children, but the founder of a study based on housework and home management in the year 1924. During the development of this study, Dr Lillian Gilbreth analysed the specific motions in food preparation and applied reorganizing principles in order to eliminate all repetitive steps within the work space. As a result, the study proposed supposedly time reducing, labour saving appliances and/or devices. The study was published in the form of books and articles. The work of Dr Lillian Gilbreth serves as a benchmark of acceptable housekeeping and is still applied to several kitchen models at present.

Figure 22 Frank and Lilian Gilbreth with nine children

During the time in which the student conducted research on the layout of industrial kitchens, a number of steps were obtained, in order to successfully execute the design of a facility with a high throughput rate. The steps will be used during the facilities design process of both the stationary kitchen and the mobile kitchen unit of the *Mobile Feeding Scheme* business engineering model project. The relevant steps can be listed as follow:

1. Determine the applicable size of the unit in square metres.

2. Identify the type of configuration. The configuration can either be ergonomic or zero-style. An ergonomic configuration entails a setup that is suitable for the chef and workers within the working environment. A zero-style configuration involve distinct areas of an assembly line in which food are prepared.

3. Sketch the layout of the kitchen on a piece of paper.

4. Place the refrigerators near the preparation area. Locate the preparation tables where equipment such as grinders, mixers and other appliances will be stationed.

5. Two sinks need to be set up in the area dedicated for the washing of dishes and other equipment. Locate another sink close to the preparation tables, for the purpose of ease should rinsing of food be required. The standard requirement of most building codes are three sinks.

6. Place the microwaves and cookers - fryer(s), the grill and conventional oven. It is important to note that a vent hood is required over the grill and fryer(s).

7. Lastly, the positioning of the shelves along the walls will take place. The shelves is often used for cookware, utensils and supplies.

14. Logistics concerning the supply and demand of food within a feeding scheme

When considering the logistics and supply chain related to the *Mobile Feeding Scheme* project, numerous factors need to be considered including the durability of the products grown within the stationary agricultural garden, the shelf life of each of the crops harvested, shortcomings and the relevant procurement schedule.

Figure 23 illustrates the entire supply chain process that need to be considered when planning a project, such as the *Mobile Feeding Scheme*. The picture illustrates the entire supply chain related to each of the following entities: the suppliers-supplier, the supplier, the relevant company or organisation, the customer and lastly, the customer's customer.
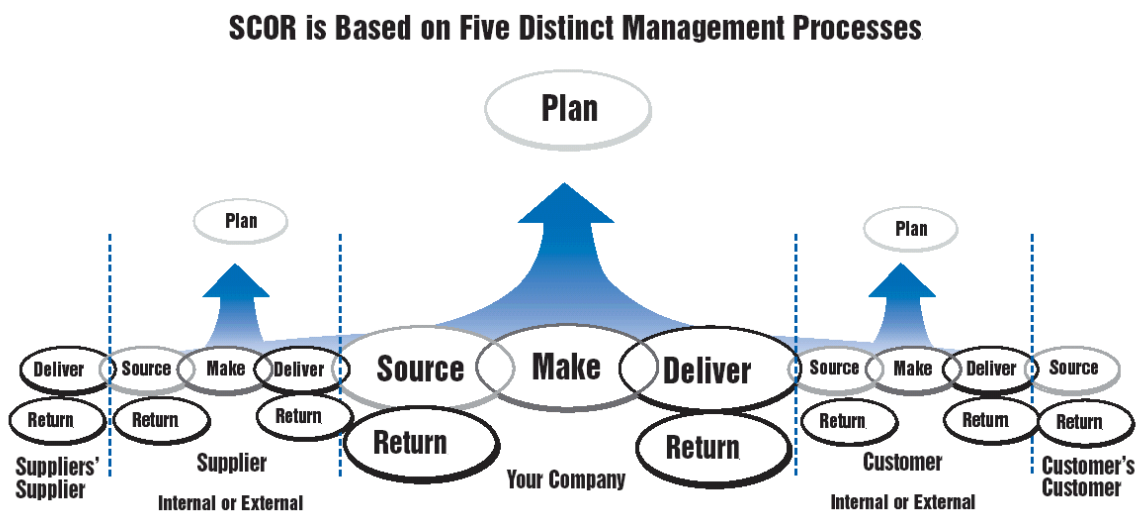
Figure 23 A pictorial representation of the SCOR Framework model

15. Feasibility test

A feasibility test can be defined as the phase in which practical constraints are considered. With regard to the *Mobile Feeding Scheme* project, a feasibility test has to be executed in order to validate the proposed business engineering model.

Feasibility tests can bring about questions that are related to the implementation of the selected alternative, over time. The consideration whether the possible implementation of the alternative is feasible and legal, is of utmost importance. Furthermore, personal and social constraints have to be investigated.

Enabling the decision maker to focus on the relevant project constraints, will imply that the ethical considerations be integrated with all the aspects of a decision.

During the time in which the student conducted research on feasibility testing, the student came upon an ImpactCs framework indicating a number of steps that can be followed during the execution process in which the feasibility tests is applied. The research can be summarised as indicated in Table 10, where the decision maker has to consider each of the subsequent practical constraints.

Table 10 The ImpactCs framework

No.	Constraint	Descriptive Question
1.	Time	Is there a project deadline, for the investigation and problem resolution? Is the project deadline fixed or negotiable?
2.	Financial	Does the solution entail cost constraints? Are the relevant cost constraints fixed or negotiable?
3.	Legal	Does the project proposed alternative violate rules, regulations or laws? Are the legal constraints, in line with the results of the ethical evaluation of the project? If the answer to the previous question is *no*, what can you do to align them?
4.	Personal	Do the people involved with the relevant project offer potential constraints, because of their personalities?
5.	Social, Cultural, or Political	Consideration of the direct environment and/or community in which the relevant project will be implemented. What would the response of the community be, considering all social-, cultural- and political aspects?

2.3.2 Phase II – Engineering Development

Phase II of the *Mobile Feeding Scheme* business engineering model project data collection, is a summarised reflection of research related to the production of the mobile kitchen unit initially requested by the three individuals. Due to the fact that all activities and tasks related to the execution of the *second* phase will be outsourced, the literature obtained within the sub-sections of the *phase II - engineering development* section will only be sufficient for recommendations with regard to possible manufacturers for the mobile kitchen unit and features to be included in the mobile kitchen unit.

1. The procedure for the production of the mobile kitchen unit

The general procedure for the development of trailers, was researched within *the procedure for the production of the mobile kitchen unit* sub-section that follows. The information obtained will enable the student to stipulate the methodology that needs to be followed for the construction of the *Mobile Feeding Scheme* trailer, which is a made-to-order product.

Furthermore, it is of utmost importance that the individual responsible for the design of the made-to-order product is competent, abreast with up-to-date tools and techniques, and is capable of executing judgement in decision making during both the problem solving- and design phases.

When designing a trailer it is essential to consider variables, such as suspension, frame, total weight capacity and the final height of the trailer. Each of the variables mentioned, is dependent on the trailer type and classification. Trailers can be classified as light- (I), medium- (II), heavy (III), extra heavy- (IV) or maximum heavy duty (V) weight ranges. An adequate axle kit must be chosen.

Since the base for all structure types are similar, the student conducted research based on the procedure of a basic type structured trailer that can be viewed in Figure 24 below.

Figure 24 Pictorial representation of a basic type structured trailer

The procedure in which the basic type structured trailer illustrated in Figure 24 is manufactured, can be defined using the sequential steps listed in Table 11.

Table 11 The sequential steps for manufacturing a basic type structured trailer

Step 1	The respective parts that will be used for the manufacturing of the main frame need to be cut up and welded together, making use of a cut-off saw and welder. The structural flatness and shape need to be put to the test before any further processing steps can be executed.
Step 2	The step in which the axle is positioned according to the specifications of the type of trailer. In the case of a tilting trailer, the axle will be positioned towards the central point of gravity.
Step 3	Once all the previous steps mentioned are completed, the tongue weight have to be calculated. The tongue weight should be between ten and fifteen percent of the gross trailer weight. Tongue is primarily determined by the trailer tape and classification. The tongue weight obtained will be sufficient if the customer wants to trail the trailer, after the trailer is unloaded.
Step 4	Step four entails an aspect that is critical for the manufacturing of a trailer. The axle has to be square and centred with the frame, in other words the axle has to be in line with the centre line of the frame. Thus, the tongue will also be square and centred to the frame. A general test that is executed by manufacturers to ensure that the tracking is straight, involves measuring the distance between the wheels to the hitch which has to be equal.
Step 5	In step five the tongue is mounted to a cross bar ahead of the axle, whilst having the frame upside down. The object will have a solid round bar at the end and the tongue will be formed by a square tube. Two mounting tabs, each containing half inch holes, will be stationed with the round bar between them. The mentioned assembly is essential for the pivot action needed, for the trailer.
Step 6	During the execution of step six a latch is attached, preventing the trailer from tilting. It is of utmost importance to be latched to and object to ensure its place.
Step 7	Fenders from small rods will be welded into the system using low heat. The fenders will be reinforced with angle iron, which can once again be used as purpose driven mounting points. Trailer rails can be installed on the side, making use of angle iron. The fenders can be attached to strengthen the system.
Step 8	Vertical pieces made from angle iron that are welded together, can be installed should a gate be demanded by the relevant customer.

2. Material selection for the production of the mobile kitchen unit

The following sub-section reflects information obtained with regard to possible materials, which can be used for the manufacturing of the *Mobile Feeding Scheme* project trailer.

Trailers were originally manufactured using steel, although aluminium and in some cases even plastic, are the materials of preference at present. Research related to each of the mentioned materials were conducted and summarised below.

Steel	• Research indicated that steel is the most common material used for the production of trailers. Steel is without a doubt regarded as the best suited material for large, high volume freight shipments. • Compared to the metallic element Aluminum (Al), steel is approximately sixty six (66) percent stronger. • Steel can be regarded as a more flexible material, because of its large area of elastic formation - enabling the material to retain its original shape over a period of extended use. • Steel products often require a finishing coat to increase durability and limit corrosion.
Aluminum	• Aluminum is a cost effective metallic element, of which approximately twenty five (25) percent in total, is recycled. Research showed that this material is more cost effective when used in minimalistic quantities. • The material is best suited for a compact, lightweight structured trailer which is designed to convey small, low volume loads. • The strength of Aluminum is lower than, nor have the same level of flexibility as, steel. This imply that the area of elastic formation is significantly smaller compared to that of steel. Thus, the material will easily experience plastic formation and therefore the specific material is unable to bear the load of a heavy freight. Aluminum fatigues and wears much quicker than steel. • The demand for Aluminum budget trailers recently increased remarkably.

Plastic	• Plastic can be regarded as a product of innovation, since the high molecular weight plastic that is being incorporate more regularly with aluminum trailer designs nowadays. This material is used to improve existing trailer designs.
	• The combination entails that the aluminum frames are meld with polythene plastic sheets. This enables the production of economic, light weight structures. When comparing cost, it is more cost efficient than both an all aluminum- and steel trailer.
	• The mentioned process can be used for the building of larger structures that is cost effective (due to the reduction in the level of metallic material to be used) and foreseen for high volume shipments of light weight freight.

3. Minimum requirements for a mobile kitchen unit to be road worthy and to obtain the necessarily documentation

According to the Department of Trade and Industry, requirements relating to the metrological data of trailer dimensions shall comply with the regulations of the National Road Traffic Act, 1996 (Act 93 of 1996), with the exception as provided for in section 4.1.2, section 4.1.3 and section 4.1.3 of the Act.

Furthermore, the registered manufacturer of the trailer(s) has several minimum requirements (coupling, stability, trailer weight, etc.) that need to be met, in order to successfully register the product as roadworthy.

4. Supplementary mobile kitchen unit features

The possibility of including additional features to the *Mobile Feeding Scheme* trailer, surely exists. However, the features will only be incorporated with the design of the mobile kitchen unit, should the customer approve.

Research relating to mobile water purification equipment, the significant increase of internet users in South Africa and possible methods of airtime procurement, was conducted. The data obtained with regard to each of the topics mentioned, can be viewed in the following sub-sections.

4.1 Mobile water purification equipment

GE Power & Water is a single company specialising in water and process technologies that are capable of helping communities in need of fresh, drinkable water within less than two hours. The company has a fleet of trailer based systems that guarantee both water quality and quantity, which complies with all necessary environmental regulations.

The GE mobile water treatment features can be categorised in four categories: resin, membrane, filtration and the category referred to as other water treatment. There are numerous routing applications, including water recycling, which can be executed by GE.

For the purpose of the *Mobile Feeding Scheme* business engineering model, the student will consult the GE company, considering all possibilities of installing the company mobile water purification equipment on the *Mobile Feeding Scheme* project trailer. The addition of the mobile water purification equipment will ensure that the relevant children of Blaauwbosch Primary School and the nearby situated schools, are guaranteed of drinkable water.

4.2 Internet users within South Africa

According to the internet usage figures and the associated population statistics obtained, an increase of five (5) percent in the total number of internet users (of the South African population) can be noticed between the years 2000 to 2008. The information indicates a definite annual increase of South African internet users. The data that was collected, demonstrating exact figures for each of the mentioned years, can be viewed in Table 12.

Table 12 Tabulated internet usage results of the South African population

Year	Users	Population	% Users
2000	2,400,000	43,690,000	5.5 %
2001	2,750,000	44,409,700	6.2 %
2002	3,100,000	45,129,400	6.8 %
2003	3,283,000	45,919,200	7.1 %
2004	3,523,000	47,556,900	7.4 %
2005	3,600,000	48,861,805	7.4 %
2008	4,590,000	43,786,115	10.5 %

Source: Internet World Stats (2012).

4.3 Airtime procurement with the purpose of resell

The mobile network MTN recently launched a project titled *Mobile Money Reseller Project* which enables subscribers to earn up to three percent in cash rewards, when selling airtime for any mobile network in South Africa.

Advertisements in the Sunday papers reported that the commission earned will be deposited into the individual, reseller's Mobile Money account. Thus, the project will assist subscribers in building a sustainable source of income.

The *Mobile Money Reseller Project* criteria requires that the relevant candidates are South African residents of sixteen years and older. Furthermore, each reseller has to have a valid South African identification number.

However, the project has predetermined fixed maximums on the relevant accounts, which can be tabulated as follow:

Table 13 MTN maximum limits on reseller accounts

Maximum	Relevant Amount (in ZAR)
Daily debit spend	R 1000.00
Monthly debit spend	R 25 000.00
Account credit balance	R 25 000.00

Source: MTN Mobile Network (2014).

As a MTN customer, there are a number of transactional fees that have to be considered. The related transaction fees listed in Table 14 were obtained from the MTN website.

Table 14 MTN seller associated transactional fees

Transaction type	Relevant Transactional Amount (in ZAR)
Withdrawal of money at participating Pick 'n Pay stores and Boxer outlets	R 4.00
Using Cash Back rewards at a till	R 4.00
Debit orders	R 3.00
Sending statements by means of e-mails	R 9.00
Disputed EFT credit reversal	R 9.00

Source: MTN Mobile Network (2014).

Transactions, such as depositing and making payments at a till point, sending money or using the Mobile Money obtained to purchase prepaid electricity or -airtime, are free of charge.

5. Power generating methods for the mobile kitchen unit

The student decided upon investigating numerous methods of power generation, since the *Mobile Feeding Scheme* trailer would require some source of power. The two alternative methods that were identified, besides the use of electricity generated by the national supplier ESKOM, with regard to the *Mobile Feeding Scheme* trailer are: solar panel systems and LP gas systems.

Solar panels consisting of photovoltaic (PV) cells, are available in a range of several power output options - from three (3) Watt to two hundred and eighty (280) Watt. The PV cells cause absorbed photons from the sun to be converted into electricity by means of semiconductor based solar cells. Three (3) Watt solar panels are usually configured together for the purpose of charging twelve (12) Volt batteries, ideal for powering a simple lighting system. The one hundred and twenty (120) Watt solar panels can be configured together to produce a total, specific output. Other components that are necessary when primary obtaining power from solar panels, is an inverter (should the user prefer to work with two hundred and fourty (240) Volt electricity), a smart metre (for use on grid only) and a voltage regulator. The price range of the various solar panel makes and capable output configurations, vary significantly. A summary of single prices that was obtained by means of an electronic source, can be viewed in Table 15.

Table 15 Single solar panel price range

Solar Panel Make	Output	Price (in ZAR)
SOLAIRE	120W	R 1350.00
SOLAIRE	10W	R 147.00
RENESOLA	250W	R 2799.00
RENESOLA	255W	R 2855.00
RENESOLA	300W	R 3299.00

The second alternative method mentioned is LP gas systems, which is wining more field lately, due to the fact that it is economic, fast (no preheating or uneconomic after heating), controllable and efficient. It is said that gas hob settings are often more precise than electric hobs and the consumer only have to pay for the gas consumed. Gas is advantageous in the sense that it is portable and can be stored in a safe environment.

6. Commercial mobile kitchen unit manufacturer - Echo 4x4

For the purpose of the *Mobile Feeding Scheme* project, research related to the existing product range of a single commercial trailer manufacturer was conducted. Although the product range of the Echo 4x4 manufacturer primarily accommodate consumers who would like to use the relevant products for camping, configurations can be made. The student will request a quote from the commercial manufacturer, once the design for the *Mobile Feeding Scheme* trailer within the final project report is finalised.

Echo 3 off-road trailer

Echo 3+ off-road trailer   **Echo 4 off-road trailer**

Figure 25 Echo 4x4 off-road trailer product range

The entire Echo 4x4 off-road trailer product range, which can be viewed in Figure 25, is fully equipped with gas stoves (and gas bottle), a fridge and/or freezer unit, a water tank and jerry cans. Echo 4x4 provide all necessary awnings, groundsheets, tent poles, pegs, ropes, furniture, kitchen crockery, cutlery and braai equipment over and above the purchased unit.

7. Private mobile kitchen unit manufacturers

Research relating to privately owned South African companies, capable of manufacturing customised trailers were conducted. Single companies, who are primarily located in the Gauteng province, were identified as potential candidates to manufacture the made-to-order *Mobile Feeding Scheme* product. The researched list of companies can be observed in Table 16.

Table 16 Single privately owned companies manufacturing customised trailers in South Africa

Company Name	Location
Decleor 4x4 & Trailers	Alberton, Gauteng
STR Scholtz Trailers	Centurion, Gauteng
DAMS Trailers	Johannesburg, Gauteng
Travel Light Trailers	Krugersdorp, Gauteng
Xtreme Trailers	Pretoria, Gauteng
Dura Trailers	Randfontein, Gauteng
Custom Trailer	Gauteng
In Tempo Trailer Manufacturers	Cape Town, Western Cape
Hambisa	Newcastle, KwaZulu Natal

The student responsible for the execution of the *Mobile Feeding Scheme* business engineering model project, will request a quote from specific privately owned manufacturers once the design for the mobile kitchen unit is finalised.

2.3.3 Phase III – Post Development

1. Food safety and quality regulations in South Africa

Research related to the regulating of food safety and quality, from a consumer perspective, were conducted. The data that was collected, clearly indicated that it is a basic human right to have access to food that is safe and affordable. In order to exercise this right, appropriate regulatory systems are of utmost importance to protect the consumer against possible risks through the consumption of food, due to the fact that it could have a direct impact on consumer health.

The following national departments are primarily responsible for the food safety and food quality legislation in South Africa:

1. The Department of Agriculture
2. The Department of Health
3. The Department of Trade and Industry

It is the responsibility of the Department of Agriculture to ensure that the safety and quality of all agricultural- and animal products comply with the Agricultural Product Standards Act of 1990.

The key function of the Department of Health is to confirm that all food related products are safe for consumption by humans with regard to the Foodstuffs, Cosmetics and Disinfectants Act of 1972, also referred to as the FCD Act. Numerous aspects are addressed within the FCD Act, such as the manufacturing process, labelling, sales and the importation of food related products. Furthermore, the FCD Act entails the integration of approved, acceptable sources such as: Codex Alimentarius standards and guidelines, the Fertilizers, Farm Feed, Agricultural Remedies and Stock Remedies Act 26 of 1947, the Medicines and Related Substances Control Act 65 of 1963 and lastly, the Genetically Modified Organisms Act 15 of 1997. Due to the fact that the above mentioned sources are pro-active, a group of competent, independent government officials have to conduct a risk assessment and approve each product before the product is released on the market.

The development of regulations that contribute to the FCD Act, requires knowledge from experts in specific fields, such as additives, irradiation of food, microbiology and mycotoxins. Thus, a group of academics, scientists, consumers and representatives of a number of industries and organisations titled the Food Legislation Advisory Group (FLAG), was established in order to advise the government.

Matters associated with the hygiene of food related products are censored by the National Health Act of 2003, whilst the International Health Regulations Act of 1974 regulates the hygiene requirements of ports and airports.

The South African Bureau of Standards (SABS), which is under the jurisdiction of the Department of Trade and Industry, is responsible for ensuring the compliance of canned- and frozen meat products with the Standards Act of 1993.

Consumers are protected against contaminants and toxins, based on the safety of presumption. Should a substance contain additives or contaminants, maximum regulations are applicable.

During the year 2009, a Consumer Protection Act was signed into Law by the South African government, which came to effect in stages - with the final stage being enforced during 2011. The Consumer Protection Law makes provision for the shortcomings that were identified with regard to the protection of consumers.

Although the Consumer Protection Act ensures protection for consumers, there are a number of areas which are not addressed. The areas include price increases by retailers, wholesalers and manufacturers to minimise potential losses and to cover lawsuit expenses.

Over and above the fact that legislation is put into place to protect the consumer, the government cannot be kept liable for a consumer's actions. It is of utmost importance that each consumer strive towards becoming knowledgeable on the topic of purchasing, handling, preparing and storing food, in order to make informed decisions and practically apply the necessary safety requirements.

Lastly, the labeling of products has to conform to the Food Labeling Regulations (Gn R146), the Agricultural Products Standards Act (for example dairy products), the Fruit Juice and Fruit Drink Regulations, the Foodstuffs, Cosmetics and Disinfectants Act (for example packed- or bottled water), in addition to the Consumer Protection Act.

The research relating to the food safety and quality regulations applicable within South Africa, were primarily conducted to establish all legal aspects that need to be deliberated within the *Mobile Feeding Scheme* business engineering model.

2. Safe quality food standard certification

The scheme titled SGS, developed a product which is specifically designed as a food safety program. The relevant product offers a safe quality food (SQF) standard certification for organizations who handles, prepares, processes and produces food related products to the highest possible standards.

The food safety program primarily focus on production (SQF 1000), together with food manufacturing and distribution (SQF 2000). The SQF program is capable of addressing a unique certification program feature, which entails product quality up to level three. The three levels of certification which are available for both SQF 1000 and SQF 2000, can be listed as follows:

- Level 1: Food Safety Fundamentals

- Level 2: Certified HACCP Food Safety Plans

- Level 3: Comprehensive Food Safety and Quality Management Systems

Lastly, it is important to note that the SQF certification program is recognised by the Global Food Safety Initiative (GFSI).

3. Water purification regulations in South Africa

The Department of Water Affairs is responsible for the quality regulation of drinking water in South Africa. Predetermined set systems are put into place for the relevant responsible institutions, by the Department of Water Affairs, in order to ensure the steady and sustainable improvement of the Division of Water Quality (DWQ) management. The system is enforced at municipal level through the implementation of the Blue Drop Certification Programme, with the sole purpose of standardising the water consumption quality of tap water throughout South Africa - for both South African- and international consumers.

The Blue Drop Certification Programme is dependent on the participation of South African citizens due to the democratic society, which imply that the South African citizens act as the regulators. The primary motive for the engagement of the public sector includes the possible enhancement of accountability between the provider and the South African citizen, through establishing communication channels. The developed channels will give the consumers an opportunity to voice their needs, which will enable the municipalities or Water Service Authorities to respond and develop a reflective system accordingly.

Furthermore, the National Water Act of 1998 (no. 36 of 1998) and the Strategic Framework for Water Services are key documents used as a legal framework for water safety and regulations.

The water safety and regulations data that are relevant to South Africa, was obtained for the purpose of establishing a legal framework to which the *Mobile Feeding Scheme* business engineering model should adhere. However, the legal requirements related to the purification of water will only be incorporated in the model, should the customer request the addition of the mobile water purification equipment (developed by the company GE), to the mobile kitchen unit.

4. The B-BBEE legislative framework in South Africa

Apartheid in South Africa, affected the majority of South Africans through limited economic participation, legislation restriction and the confined creation of wealth that resulted in an unjust and unequal governmental system. Democracy introduced democratic values, which enforce equity for all. This twenty year old political dispensation promises to radically transform all values of inequality, such as racial and gender entrenched prejudice, to ultimately correct the inequalities of the past.

Three aspects which are directly related to the transformation of inequality, and therefore to the implementation of democracy, are: affirmative action, B-BBEE and the formation of the legislation framework applicable in South Africa.

The programme specifically developed to ensure affirmative action, has a primary objective of reversing discrimination through applying the constitutional test.

Due to recently implemented legislation, regarding B-BBEE in South Africa, it is recommended that a noteworthy percentage of top priority positions be filled with competent black employees. The B-BBEE legislative framework entails the dti's Broad-Based Black Economic Empowerment Act (2003/2004), together with the Codes of Good Practice, lay the foundations, be functional and finally, be implemented within existing- and future businesses.

Concerning the *Mobile Feeding Scheme* business engineering model project, it is advised that the B-BBEE legislation be incorporated within the business model, by means of funding and managerial positions.

Should international companies be interested in investing within South Africa, the South African laws applicable to governing within the country will remain relevant. It is of utmost importance for international companies to embrace the South African B-BBEE policies put in place, should the relevant companies like to be regarded as valued partners and respectable corporate citizens.

5. Sustainable farming practices in South Africa

Sustainable farming practices are of utmost importance, to ensure that the agricultural land within South Africa is preserved for the generations to come. Thus, the WWF-SA is engaged with several activities within South Africa, in order to ensure sustainable agricultural practices that minimises the adverse impact of farming on the direct environment. The demonstration of good stewardship, of natural resources are also promoted by the WWF-SA.

Agriculture is an important sector, contributing to the South African economy through rural development and the establishment of job opportunities. Agriculture can thus be regarded as a poverty alleviation.

For the purpose of motivating sustainability within the agricultural sector, it is important to note that approximately eighty (80) percent of the South African land surface are possessed by emerging farmers, small scaled farmers or commercial farmers. This imply that roughly sixty three (63) percent of the freshwater resources within South Africa, are consumed by agriculture for irrigational purposes.

Sustainable farming practices in South Africa does not only entail the long term protection of productive land used for agricultural purposes, but also the viable production of profitable yields and the welfare of both the farmers and their employees.

The WWF-SA works in collaboration with numerous industries, such as the retail sector and government. The primary objective of the WWF-SA is to motivate innovative ideas, with regard to possibilities for establishing a connection between the food system and the eco system within the country. For the connection to be established, the direct negative impact farmers have on the environment due to specific production practices need to be reduced. An example of the preservation efforts referred to, includes the effective management of catchments, rivers, wetlands and soil. The cooperation of farmers will ensure a healthy, properly functioning natural system.

The *Mobile Feeding Scheme* business engineering model will be designed to specifically address sustainable farming practices, through minimising the adverse impact of the stationary agricultural garden on the direct environment.

6. Work design or ergonomics

Motion study, which is also referred to as work design or ergonomics, involves the careful analysis of the body and its motions employed in completing a certain task. The purpose of motion study is to eliminate or reduce ineffective movements, and facilitate and speed effective movements. Through motion study a certain job is redesigned to be more effective and to produce a higher rate of output.

The study of manual motion and the development of basic laws concerning motion economy were originally introduced by Frank and Lilian Gilbreth. Motion study includes both studies that are performed as a simple visual analysis and studies that utilize more expensive equipment.

The student responsible for the execution of the relevant project, decided upon considering work design when analyzing the working circumstances of the *Mobile Feeding Scheme* business engineering model operators.

7. Training related to:

7.1 Food preparation

During the period in which research was conducted regarding possible food preparation courses, for the individuals involved with the *Mobile Feeding Scheme* business engineering model, the student came upon a food preparation certificate program which entails courses which will equip each participant with the necessary skills on how to properly handle-, prepare- and store a variety of food items. Furthermore, adequate knowledge related to the cleaning and sanitizing regulations of kitchens and -tools, will be gained. Each candidate will be trained to work in commercial and/or industrial kitchens, in a safe manner.

The food preparation certificate program course topics can be summarised as follows:

- The preparation of food
- The procurement of food
- Guidelines on sanitation
- Safety in the kitchen
- Quality and quantity in food preparation
- An introduction to foodservice
- Restaurant internship
- Storage and care of food
- Operations related to cost control
- Preparation of cold food

Once the student completes the food preparation certificate program, the participant is competent to apply for a number of career opportunities, for example chef de cuisine, preparation chef, personal chef, restaurant manager, kitchen manager, and so forth.

7.2 Farming practices

Training relating to farming practices was researched for the purpose of the *Mobile Feeding Scheme* project. It is proven that where training related to the day-to-day work of farm workers is conducted, a significant increase in the productivity can be noticed - which will result in efficient, competitive farming practices.

In situations where new entrants are appointed, or new working methods- and/or technologies are implemented, sufficient training is of utmost importance to ensure success. Adequate training will have a direct positive impact on both productivity and human protection. Thus, the health and safety of all related employees are directly affected.

Research were conducted with regard to organisations that are capable of identifying training needs within existing practices, organisations who can develop and utilise existing skills and lastly, organisations that could assist with funding - specifically for training purposes.

Lantra can be recognised as a suitable organisation satisfying all of the above mentioned requirements. The organisation has a Skills Sector Council especially for the agricultural industry.

Another organisation is Train to Gain, which is an organisation with the primary objective of improving the skills of employees in a wide variety of businesses types. They could provide assistance in finding a local training provider and possible sources for funding.

8. Occupational Health and Safety Act (OHSA)

It is of paramount importance to consider the Occupational Health and Safety Act (OHSA) when designing or re-designing a structure, machine, operational system or even a product. Consequently, the OHSA have to be incorporated with the design of the *Mobile Feeding Scheme* business engineering model.

The hierarchy of control, indicated in Figure 26, was found during the period in which the student conducted research related to the enforcement of the OHSA in the workplace. The hierarchy of control can be used for the purpose of mitigating any form of threat to the occupational health and safety of all persons involved in the execution of a specific activity.

Elimination

Substitution

Engineering

Administrative

Behaviour

PPE
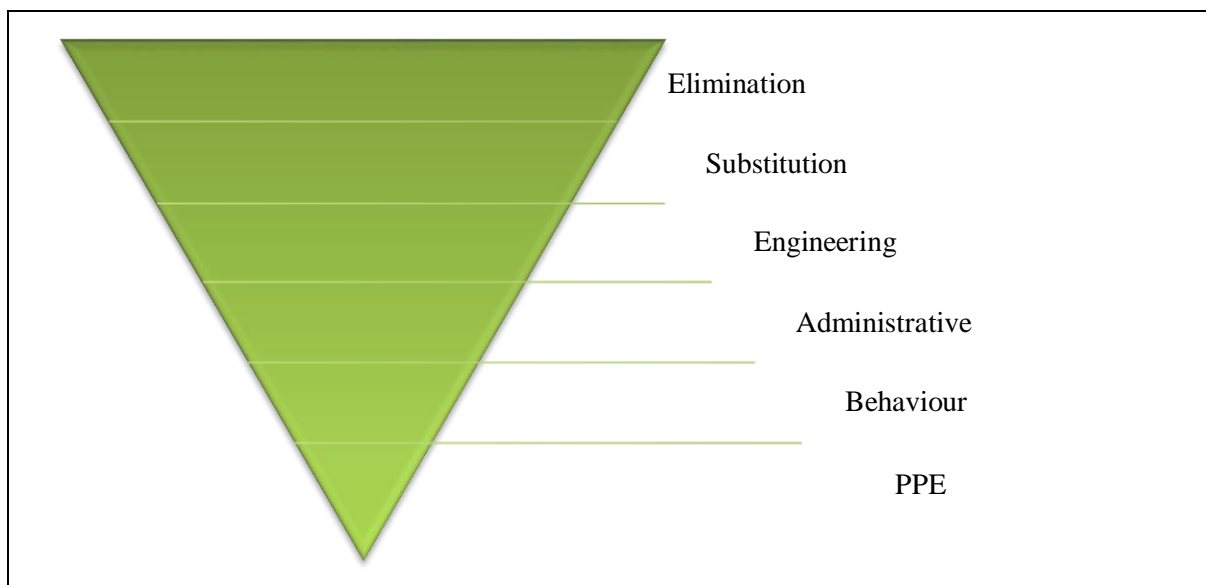
Figure 26 Hierarchy of control

Ignorance of the law is not an argument for defence. It is the responsibility of the employer, and in many cases that would be the Engineer, to ensure that the Occupational, Public Health and Safety is maintained throughout an Engineering Activity (Kotzé 2012: 665).

Furthermore, continuous assessment is vital when executing a specific activity, in addition to effective communication between management, workers and the public.

The *Mobile Feeding Scheme* business engineering model will be designed in such a way, that the regulations stated within the OHSA are applicable to each business model level.

9. Solar-powered mobile clinics

Research indicated that people stationed within rural areas often have to walk extreme distances, in order to reach their closest clinic. Thus, the statement can be made that South Africa is in great need of health care facilities within rural areas.

Recently a project involving solar-powered mobile clinics was launched by Samsung Electronics, which entails a portable medical clinic with:

- testing facilities for malaria, blood pressure and diabetes,

- eye - and dental care facilities,

- a mother and baby unit with an ultrasound,

- furthermore, health check-ups can be done for free, should the community member be registered with the mobile clinic.

Samsung Electronics has sponsored four of these solar-powered mobile clinics in partnership with NGO, up to this point in time. According to theory, the use of solar panels in combination with batteries, enable the mobile clinic trucks to operate twenty four (24) hours a day.

The mobile clinics are frequently used to enhance existing facilities at stationary clinics managed by NGO, due to the fact that specialised services are often absent at stationary clinics.

Samsung Electronics work together with local government, universities and a number of aid groups to determine the geographical optimal location of need, to position these trucks.

Although the solar-powered mobile clinics project driven by Samsung Electronics is still in the beginning phase, the project plan indicates that it will be fully operational at the start of next year. Two trucks will be employed in South Africa and the other two will service countries up in Africa. The company has a target of reaching one million people situated within the rural parts of Africa by the year 2015.

Figure 27 is a picture of the *OptiLife* mobile clinic, which is without a doubt the first in South Africa. The mobile kitchen unit consists out of two clinics that is mounted as one body.

Figure 27 The *OptiLife* mobile clinic

The specifications and features of the *OptiLife* mobile clinic, are as follows:

1. One 3.0 litre Turbo diesel chassis, appropriate for three people (that accommodates the body and diesel tank features).

2. One CD or radio.

3. Two fully equipped clinic rooms that are separated, each with practitioner hand wash basins.

4. Two examination couches that are tillable with compartments appropriate for storage.

5. Two hygienic stainless steel containers for instruments.

6. Two working desks and swivel chairs for the practitioners.

7. Two separated customised flushing toilets with hand wash basins.

8. One hand wash dispenser and a full towel.

9. Each clinic room contains fully wired low energy lighting, with separate battery powered low energy lighting.

10. AC power points in each clinic room, as well as separate battery driven power points.

11. A complete management system that is rechargeable (either by the truck engine or a direct AC line from a stationary power source).

12. An immunisation fridge with travel lock, including ruggedised medication storage cabinets containing lockable drug control, which are inclusive to the mobile clinic unit.

13. Hygienic flooring and wall coatings that are sealed, as well as extractor fans included in each compartment of the mobile clinic.

14. A sewerage disposal system with tanks included with the mobile clinic unit.

15. Electrical pumps, in addition to two hundred (200) litre of fresh water supply on board the mobile clinic.

16. Provision is made for patients waiting for extended time periods: an awning and side covers.

17. Access for disabled patients: a wheel chair ramp.

18. The mobile clinic is burglar proof with lockable access control and frosted windows.

Advanced accessories included in the *OptiLife* mobile clinic, are as follows:

1. Blood Pressure monitors.
2. GCT Blood Glucose or Cholesterol monitors.
3. Auto lancet devices.
4. HIC rapid test kits.
5. Stethoscopes.
6. Practitioner surgical sets.
7. Reflex sets.
8. Hazard bins.
9. Emergency treatment back packs.
10. Courtesy towels.
11. Three wireless computers (notebooks).
12. Built-in network connection.
13. Wireless data communication device.
14. Printer and copier units.

The data relating to the specifications, features and advanced accessories included within the four solar-powered mobile clinics, sponsored by Samsung Electronics, will serve as an example of a similar product developed to serve a community. Thus, the solar-powered mobile clinics will be used as a guideline for the *Mobile Feeding Scheme* business engineering model concept development-, engineering development- and post development phases.

10. Requirements relating to patents in South Africa

The *requirements relating to patents in South Africa* sub-section of the final project report, consists of patent characteristics, the exclusion of certain patent characteristics, the South African patenting process, relevant patent costs involved, the advantages of patent protection and lastly, information required for the patent process. The research will be used for the purpose of patenting the *Mobile Feeding Scheme* business engineering model, once the first iteration of validation is successfully executed at Blaauwbosch Primary School.

The definition of a South African patent can be summarised as an invention that is new, inventive and useful. Should an invention adhere to all three of the mentioned characteristics, a patent in terms of the South African law may be granted for the specific invention. The patent granted may however be subject to certain exclusions which will be discussed in the sub-sections that follow.

10.1 Novelty requirement

The novelty of an invention cannot be determined conclusively, but an indication of a specific patent's potential novelty can be estimated through obtaining research on patents and associated literature. It is important to note that South Africa has a requirement, referred to as the "absolute" novelty requirement, which imply that the novelty of an invention will be destroyed should a similar product be disclosed before the filing date of the South African patent application. The South African patent applicant will thus forfeit his or her patent rights.

It is often the case that inventors unknowingly destroy the novelty of their own invention, through disclosing it, prior to filing a patent application.

There are a number of acts where disclosure may be excused in terms of the South African patent law. Inventions observed in another country cannot be copied by a second party in South Africa. The second party will be rejected when trying to obtain protection for the invention in terms of the South African Patents Act, due to the fact that he or she is not the inventor. One of the three characteristics mentioned in the introductory paragraphs for the requirements related to patents in South Africa, is violated. The invention cannot be regarded as "new".

The possibility exists that the second party could exploit this particular invention in South Africa, should the invention not be protected by a patent in South Africa. An infringement search, also referred to as a freedom to operate search, can be conducted in order to establish whether the invention is protected by a patent applied for by the inventor.

10.2   Inventive requirement

Should the invention be new, but similar inventions exist that are already disclosed to the public in patent specifications and other literature, the inventive characteristic is violated. Those disclosures are often referred to as *prior art*.

The test that is often used to evaluate the inventiveness of a patent in terms of the South African patent law, is to establish whether a professional in the particular field of the invention would consider the invention to be recognisable or not. The response of the person *skilled in the art* is considered to be final. General remarks concerning the method of evaluation used, include that it is a highly subjective test. The decision to file the relevant South African patent application can thus be regarded as a business strategy.

10.3   Utility requirement

In terms of the South African patent law, abstract inventions with no significant contribution to the South African trade, -industry or -agricultural environment, cannot be patented.

Exclusions are made subject to the requirement that the invention has a practical application and can be considered to be utile. If the invention adheres to both the novelty and inventiveness requirements in addition to the utility requirement - then only, the invention may be protected by way of a patent.

10.4   The South African patenting process

The South African patenting process entails the execution of two steps over a period of twelve (12) months:

1. File a South African provisional patent application for the invention.

2. File a complete patent application within twelve (12) months of completing the provisional patent application in South Africa and every other country where you wish to obtain patent protection.

The first step is of utmost importance to ensure that the earliest possible date is attained, from which specific rights of an invention can be claimed.

The second step, which entails the completion of the patent application, will enable the inventor to claim a first or priority date from the provisional patent application.

10.5 South African patent application cost involved

The cost relating to South African patent applications vary, depending on the technical complexity of an invention. For low to medium technical complexity inventions, the cost associated with the preparation and filing of a South African provisional patent application usually range between R 8 000.00 and R 12 000.00 . The more complex the invention, the higher the associated price will be to draft the patent application. A more accurate cost estimate for the preparation and filing of the specific patent application, will be provided to the relevant inventor after a scheduled consultation session.

The filing of a complete patent application within South Africa, is more expensive. However, at this point in time the inventor will have a more truthful estimate on the commercial potential of the invention. Research related to the feasibility of the invention will also be known, before a final decision is made related to the filing of the complete patent application.

Once a patent is formerly granted, the inventor is kept liable for the payment of renewal fees, once a year. Else, a patent will lapse when the renewal fees are not paid annually.

10.6 Advantages of patent protection

The advantages of protection by means of a patent include:

- Patents can ensure that another independent citizen, or potential competitor, can be stopped form exploiting comparable ideas.

- A fixed provisional South African patent application date will be obtained, which implies that a competitor busy exploiting a similar invention during the same time period can be addressed once the patent is approved. This is however subject to the fact that the competitor's provisional patent application date is either after the date of the inventor's provisional patent application date or the complete patent application is handed in before that of the competitor.

- The inventor does not lose any patent rights during the twelve (12) month period from which the provisional patent application is filed, until the inventor claim's priority through filing a complete patent application.

- Lastly, income can be generated from a patented invention (therefore it can be regarded as a business tool), through licensing the invention or selling the patent rights of the invention.

10.7 Information required for the patent process

The information required in order to proceed with the patent process, was obtained during the time in which the student conducted research. The specific information required for patenting purposes, can be summarised as follows:

1. Invention details.
2. The details of the inventor(s).
3. The patent applicant or patentee details.
4. Lastly, details of the client.

11. Franchising

The section titled *franchising* involves a discussion of the modern franchising concept, along with the associated franchising regulations applicable within South Africa. Franchises within the South African context have to be approved by the Franchise Association of Southern Africa (FASA).

For the purpose of completing the *Mobile Feeding Scheme* business engineering model the student will specifically consider the requirements related to the registration of a franchise in South Africa.

11.1   Concept of modern franchising

Franchising originated in the Unites States of America during the middle 1960's, when Steers and a number of other known brands were established by George Halamandaris. Several supplementary sectors contributed towards the franchise period during the years that followed.

At present, franchising is the preferred means for expansion by numerous larger companies in a diverse field of products and services. The concept related to modern franchising is recognised in South Africa.

One of the foremost advantages of operating under a local brand premeditated by a franchise, involves the incorporation of local conditions. Furthermore, the changing consumer expectations can continuously be monitored by the local franchisors, which will enable the local franchisors to remain at the forefront of developments.

Two distinct primary contributing factors within the South African franchising sector, includes the fact that approximately ninety percent (90 %) of the franchising opportunities are purely based on local developed concepts. The second factor entails the high level of professionalism that is constantly displayed by the bona fide franchisors, which is based on the work performed by the informed affiliated members of the Franchise Association of Southern Africa. The affiliated members constantly presents international developments to local franchisors.

The business arrangement of a franchise involves a clearly defined business model that includes a predetermined corporate identity, a complete business system representing the relevant business at an optimal level of efficiency and lastly, pro-active assistance related to the site selection, the facility design and -layout, initial promotional activities, the hiring and training of staff, the sourcing of equipment and -products, and so forth.

The complete package described in the previous paragraph, is presented by the franchisor to potential franchisees. In return, each franchisee is responsible for the payment of an upfront fee or initial fee, when signing the relevant franchise agreement. Depending on the mutual agreement that was reached within the applicable franchise contract, the individual franchisees have to pay a predetermined amount as an ongoing fee in exchange for the continued active business assistance.

11.2   Franchising regulations in South Africa

There are several rules and regulations to consider for the registration of a franchise, through joining the previously mentioned known body for franchising in South Africa. The basis on which the FASA grants and control membership include the Code of Ethics, over and above the Business Practices to which each member has to subscribe prior to membership.

The membership criteria related to franchisors, stated by the FASA, include the approval of applications by the FASA membership committee. The period related to the approval of applications, from the relevant date of submission, is approximately four to six weeks. However, the time period is dependent on the response time of the applicant, should comments be raised by the FASA membership committee. At this point in time, annual membership fees of R 13 729.90 (excluding VAT) is demanded, with regard to franchisors. Furthermore, a single legal fee of R 3 900.00 (excluding VAT) has to be paid with the submission of the membership application.

The criteria used by the FASA membership committee, with respect to the consideration of each applicant company, includes the viability of the concept and the presence of all appropriate documentation (disclosure document, a comprehensive operations and procedures manual, and lastly, a fair and reasonable franchise agreement reflecting the Code of Ethics and Business Practices of FASA). In order to obtain full membership from the FASA membership committee, the relevant franchise concept has to be successfully operating within South Africa for at least two years.

12. Government funding in South Africa

Several Government Sponsored Non-Repayable Grants and Assistance Programs are available within South Africa, specifically for businesses that are related to manufacturing and tourism. Projects which entail research and development (R&D) of innovative products also qualify for governmental assistance. Furthermore, there are a number of grants available for definite groups of people.

Government is known as the primary source of grants or financial assistance within South Africa. The grants are awarded to specific applicants in the form of money. However, there are a number of rigid guidelines applicable when making use of these funds.

During the time in which the student conducted research on government funding and social benefits, the student came upon the following list of grants and services:

1. child support grant
2. disability grant
3. foster child grant
4. care dependency grant
5. enrol on new grant payment system
6. social relief or distress
7. international social services
8. war veterans grant
9. old age pension
10. admission to old age home
11. grant in aid

Two of the above mentioned grants provided by the South African government, grants for older persons and child support grants, will be discussed in the sub-sections that follow.

12.1   Grants for older persons

The older persons grant, previously referred to as the old age pension, is allocated to persons of sixty (60) years and older, with the purpose of seeing them through old age. The single applicant:

- Have to live in South Africa.

- Be a permanent resident of South Africa or be a South African citizen.

- Should not receive any other social grant.

- Should not be taken care of in a state institution.

- Should not own more than R 831 600.00 worth of assets or earn more than R 49 200.00 per year.

Should the applicant be engaged in a relationship (for example marriage), the combined assets value of the individuals should not be more than R 1 663 200.00 and their income should not exceed R 99 840.00 per year.

The maximum amount obtained for an older person's grant is R 1 350.00 per month, although people over the age of seventy five (75) years will receive an additional R 20.00 . Thus, a total of R 1 370.00 will be received.

The grants are paid by the South African Social Security Agency (SASSA) making use of one of the following methods of payment:

1. Cash payment at a specific pay point, on a predetermined day.

2. At a particular institution (for example old age homes) or through a procurator.

3. Post bank account deposits, or electronic deposits, into bank accounts (EFT payments).

Permission, with a letter stating power of attorney, can be granted to someone in order to collect the older person grant on behalf of an individual, should the person be unable to collect the money them self. Otherwise a procurator at the SASSA office can be appointed.

The older person grant can be reviewed by SASSA on a regular basis and should the individual receive the grant at a particular institution or through a procurator, a life certificate have to be completed annually - at the SASSA offices.

The allocated grant can be suspended by SASSA or lapse due to a number of reasons which includes: a change in circumstances, the outcome of a review executed by SASSA, failure of co-operation when the relevant grant is reviewed, death, admittance to a state institution and so forth.

12.2 Grants for child support

The child support grant can be obtained when assistance is needed in order to raise a child. There are a number of rules applicable when receiving the governmental child support grant:

- The relevant child has to be under the age of eighteen (18) years.

- The child should not be taken care for in a state institution.

- The primary caregiver should not be paid to look after the child.

- The child has to live with the primary caregiver identified.

- The person responsible for the child (parent, grandparent, child over the age of sixteen (16) years, and so forth) has to be the primary caregiver. Proof (a report from a social worker, an affidavit from a police official or the biological parent, a letter from the school principal of the school where that relevant child is enrolled) stating the primary caregiver may be requested.

- The caregiver has to be a South African citizen.

- Both the caregiver and the relevant child have to be permanent residents of South Africa.

- A single caregiver may not earn more than R 34 800.00 per year. Should the caregiver be married, the combined income may not exceed R 69 600.00 per year.

Furthermore, the South African government specifies that a caregiver may not receive a child support grant for more than six children, should the children not be the biological children of the caregiver or the children not be legally adopted.

An amount of R 310.00 is received on a monthly basis, for each child sheltered by the caregiver.

Similar to the older person's grant, the child support grant is also paid by the South African Social Security Agency (SASSA) using one of the following methods of payment:

1. Cash payment at a specific pay point, on a predetermined day.

2. At a particular institution, performing as the administrator of the child support grant.

3. Post bank account deposits, or electronic deposits, into bank accounts (EFT payments).

Should the caregiver be unable to collect the money themselves, someone can be appointed with power of attorney to collect the child support grant on behalf of the caregiver. Otherwise, a procurator at the SASSA office can be selected.

Child support grants may be reviewed by SASSA at any point in time, where the income of the caregiver may once again be requested as well as a life certificate of the child. Should the caregiver receive the child support grant through the bank, a procurator or at a particular institution, the caregiver has to annually complete a life certificate for the child - at the SASSA offices.

The child support grant allocated to a specific caregiver can be suspended at any point in time. This may be done by SASSA. Furthermore, the child support grant can lapse due to a number of reasons. Factors that can contribute towards the suspension or lapse of the child support grant include: a change in circumstances, the outcome of a review executed by SASSA, failure of co-operation when the relevant grant is reviewed, fraud committed by the caregiver or misrepresentation of the child, death, admittance into a state institution and so forth.

Several Government Sponsored Non-Repayable Grants and Assistance Programs are available within South Africa, specifically for businesses that are related to manufacturing and tourism. Projects which entail research and development (R&D) of innovative products also qualify for governmental assistance. Furthermore, there are a number of grants available for definite groups of people.

Two of the above mentioned grants provided by the South African government, grants for older persons and child support grants, will be discussed in the sub-sections that follow.

The two grants (grant for older persons and child support grant) that are provided by the South African government, were researched for the purpose of the *Mobile Feeding Scheme* project. The respective figures associated with each of these grants might be referred to, within the *financial considerations* section of the final project report.

13. Vehicles capable of towing mobile kitchen units and the relevant price ranges

Data relating to vehicles with excellent towing capabilities, was obtained for the purpose of executing the *third* phase of the *Mobile Feeding Scheme* project. An in depth investigation of two of the top vehicles identified, were conducted in the *vehicles capable of towing mobile kitchen units and the relevant price ranges* sub-section. The estimated price range of each of the two specific vehicles, is conveyed in the same section.

The list of top ten vehicles and their relevant models, graded according to their towing capabilities, can be observed in Table 17.

Table 17 Top ten vehicles for towing

SUBARU FORESTER 2.0D

SUZUKI GRAND VITARA DDIS

LAND ROVER FREELANDER2 TD4

FORD FALCON

MITSUBISHI PAJERO

JEEP GRAND CHEROKEE

ISUZU D-MAX

MAZDA BT-50

TOYOTA 70 SERIES LANDCRUISER

TOYOTA 200 SERIES LANDCRUISER

For the purpose of the *Mobile Feeding Scheme* project the ISUZU D-max and MAZDA BT-50 were considered after a number of the vehicles listed above, was eliminated based on a predetermined set of criteria.

Although the ISUZU D-max did not receive the highest towing weight rating in the one-ton class, it is said to be the most comprehensively developed, most efficient and most refined pick-up, yet. The ISUZU 3.0 litre, four cylinder effortlessly produces 380 Nm from 1 800 rpm and is matched with three speed transmissions, which is manual or automatic. The vehicle has a good fuel economy and the 4WD models have a 3 000kg (3 ton) brake towing capacity.

Buying an ISUZU D-max in South Africa, will include a standard 36 month or 100 000 km manufacturer warranty and an extended warranty by the importer for up to 60 months or 120 000 miles (which is almost 200 000 km), whichever comes first.

The ISUZU D-max are available in a number cab configurations, which include extended cab, single cab and double cab. The relevant prices range from R 191 000.00 for the single cab (2WD derivative), up to R 284 000.00 for the top of the range double-cab automatic.

The entry model consists of standard equipment, which includes aircon, powered windows, day time running lights and front-, side- and curtain airbags.

Research showed that the BT-50 Ford Ranger twin is also a notable alternative when considering the MAZDA BT-50. For the purpose of the project, the student selected the MAZDA, due to the fact that the MAZDA is usually less expensive and is built with a firmer suspension, which is more ideal for towing. The new MAZDA BT-50 includes the flexibility and comfort features of both a pick-up truck and that of a passenger car.

The 3.2 litre three cylinder turbo diesel engine, that produces 174 kW and 470Nm of tongue from 1750 rpm, is mated with either a six speed manual or automatic transmission. The mentioned specifications of the MAZDA BT-50 empowers hauling up to 3 350 kg. The stability control system includes trailer sway control. The MAZDA BT-50 is available in either petrol or diesel.

The MAZDA BT-50 is available in three body types (double cab, single cab and freestyle cab).The prices of the relevant MAZDA BT-50 range from R 354 200.00 for the single cab, R 398 970.00 for the freestyle cab and lastly, R 462 210.00 for the double cab. However, the safety features that are included with the relevant MAZADA BT-50 model can be listed as follows: 4W-ABS, a Traction Control System, Driver Stability Control, Emergency Brake Assist, a Brake Override System, Load Adaptive Control, Trailer Sway Assist, Roll Stability Control, Hill Launch- and Hill Decent Control. A rigid cabin, front-, side- and curtain airbags are incorporated as passive safety features, a shock absorbing steering column and finally a crushable brake pedal.

There are numerous aspect to consider when pulling a trailer, in order to ensure your safety and that no harm is done to the vehicle towing the trailer. The trailer to be towed need to be mechanically sound with good tires and proper lighting. It is of utmost importance to ensure that the trailer tongue and towing weight is not exceeded, in addition to the vehicle's rated towing capacity.

Should the recommended capacities be exceeded, the load being towed will affect the braking and handling of the vehicle towing the load. In doing so, safety will not only be put to risk, but serious damage can be caused to the drive train of the towing vehicle.

A recommendation related to the post development phase of the *Mobile Feeding Scheme* business engineering model, will be made with regard to the two specific vehicles discussed in this sub-section of the final project report.

3   Phase I – Concept Development

The *concept development* section of the *Mobile Feeding Scheme* business engineering model involves the execution of the concept development phase (phase I), using the concept development sub-divisions illustrated in Figure 4 within the *project approach* sub-section of the final project report. The three sub-divisions, included within the concept development phase of the system life cycle model, can be listed as follow:

1. Need analysis

2. Concept exploration

3. Concept definition

For the purpose of the *Mobile Feeding Scheme* business engineering model each of the three sub-divisions listed above, were used as guiding principles in addressing the numerous topics within this section.

3.1 Need Analysis

The execution of a need analysis within the concept development phase is of utmost importance to indicate that a valid operational need exists, in addition to evidence of an existing potential market. The need analysis will serve as justification for initiating the development of the new system, which is in this case the *Mobile Feeding Scheme* business engineering model.

3.1.1 *Mobile Feeding Scheme* business engineering model operational need

A summary of the operational need, undoubtedly stated within the *problem statement* sub-section of the final project report, can be studied within the paragraphs that follow.

The voluntary, independent individuals who are currently preparing two meals per day at the Blaauwbosch Primary school situated within the Osizweni community, are in need of a mobile kitchen. The mobile kitchen unit will be used to provide the pupils of the Blaauwbosch Primary school and nearby situated schools with food, making use of a single stationary geographic optimal located stationary agricultural garden- and kitchen facility. The mobile kitchen unit will be used to transport the food to the nearby situated schools.

Thus, a comprehensive business engineering model that is applicable to all South African schools in need of a feeding scheme, is requested. The business model should include: the proposal of an appropriate balanced diet, the design of a feasible stationary agricultural garden, the layout of both a stationary kitchen and mobile kitchen unit, the logistics and supply chain channel to be followed, all relevant work flow and systems involved, a procurement schedule and lastly, a feasibility assessment.

Additional facets that need to be included within the business engineering model: the production of the mobile kitchen unit, all aspects related to the success of daily operational processes, necessary procedures for the registration of a patent, the identification of possible stakeholders, financial considerations, implementation schedules and procedures, and lastly the registration of a non-profit franchise have to be considered in order to complete the business engineering model.

The business engineering model will be implemented and validated at the Blaauwbosch Primary school as a first iteration, where after it can be applied at every single South African school in need of a feeding scheme.

3.1.2   Statistics related to the South African population

The figures reflected within the *data collection* sub-section of the final project report, indicate an increase of two hundred and four (204) percent in the total South African population over the past fifty three (53) years. An unemployment rate of 24.10 percent was recorded on the 31st of December 2013. The forecasted unemployment figure with regard to the total South African population for the 31st of March 2014 was 24.20 percent.

Furthermore, the published South African HIV and AIDS population figures revealed an increase of eleven (11) percent in the number of annual deaths for the time interval of 2006 and 2010. In addition to the number of annual deaths reported for the specific period, statistics indicated that the noted deaths are specifically among people between the age of twenty five (25) and fourty nine (49). The significant increase in the South African population could partially contribute towards the incline in the number of annual deaths reported.

Statistics, published by Statistics South African in 2011, reflected the percentage of double orphans incorporated in the South African population. An illustration of the relevant percentage of double orphans, can be viewed within Figure 13 of the concept development phase *data collection* sub-section of the final project report. The annual cumulative percentage of double orphans recorded within South Africa, was between four and six percent of the total population in the year 2011.

The statistics related to the increasing population in South Africa, the forecasted unemployment rate of the South African population, the published South African HIV and AIDS population figures. Finally, the numerical value reflecting the percentage of double orphans incorporated in the South African population stated above, verify the ever increasing demand for the implementation of a *Mobile Feeding Scheme* business engineering model orientated project.

3.2   Concept Exploration

The primary objective of the concept exploration segment included within the concept development phase, is to ensure the transformation of the operationally orientated view(s) of the requested system investigated in the *need analysis* sub-section. This imply that the operationally orientated view has to be converted into an engineering orientated view, in order to establish reasonable grounds for the selection of a functional system concept that is acceptable for the purpose of the *Mobile Feeding Scheme* business engineering model.

3.2.1   Fact finding techniques

Two fact finding techniques were used within the *concept exploration* sub-section of the concept development phase, for the purpose of transforming the operationally orientated view into an engineering orientated view. The fact finding techniques included interviews with a number of individuals and questionnaires. The information obtained through the respective interviews and the completion of the questionnaires, will be reflected within the literature study, the *business engineering model diet*-, the *mathematical model* and finally the *feasibility assessment* sub-sections of the final project report.

With regard to the proposed *Mobile Feeding Scheme* business engineering model, interviews will only be conducted for the execution of the first iteration of validating the business engineering model at the Blaauwbosch Primary school. The process in which questionnaires have to be completed, for the purpose of establishing an appropriate diet, have to be repeated for schools situated within provinces other than KwaZulu Natal.

a.   Interviews

The scheduled, personalised sessions commenced once the Committee for Research Ethics and Integrity at the University of Pretoria approved the questions that had to be answered during the interviews with the relevant individuals. Each individual that was interviewed, had to sign an informed consent form in which he or she voluntarily gives their permission to participate in the project and state that the relevant party is aware of the fact that the results of the investigation may be used for the purpose of publication. The relevant informed consent form can be seen within Appendix E.

The individuals that were interviewed served as informants and the information obtained from each interview contributed towards the sub-sections of the concept development phase.

Interviews were conducted with three groups of individuals: a dietitian and the group of three independent volunteers currently involved at the Blaauwbosch Primary school feeding scheme. The questions that were asked at the respective interviews, can be viewed on the subsequent pages.

A. Dietitian

1. What is the impact of not receiving a balanced diet on the physical- en intellectual capabilities of a child?
2. What characteristics contribute to the fact that a diet can be regarded as balanced?
3. What specific group of food is of utmost importance for intellectual development?
4. The possibility of replacing certain fruit or vegetables, due to similar nutritional value - should a specific fruit or vegetable not be available.

B. Three independent parents of the *Blaauwbosch Primary School*

1. How many pupils at the Blaauwbosch Primary School are currently benefitting from the government subsidized feeding scheme?
2. How many children are currently receiving a second meal, at the Blaauwbosch Primary School?
3. Does the feeding scheme currently provide the children with food over weekends and during school holidays?
4. Are there any permanently employed personnel at the Blaauwbosch Primary school responsible for the maintenance of the school terrain?
5. What does the future planning of the independent volunteers of the Blaauwbosch Primary school entail? Were potential sponsors for the development of the feeding scheme consulted up to this point in time?

b. Questionnaires

The relevant questionnaires were completed by the grade 6- and 7 pupils of Blaauwbosch Primary school, with the primary objective of establishing the food preferences of children.

The parent or guardian of each pupil under the age of sixteen, was requested to sign an informed consent form prior to the completion of the questionnaires. Signing the informed consent form, the relevant individual voluntarily gives their permission on behalf of the child, attending school at Blaauwbosch Primary, for participation in the project. Furthermore, signing the informed consent form indicates that the party is aware of the fact that the results of the investigation may be used for the purpose of publication.

The relevant informed consent form can be viewed within Appendix E, along with an example of the questionnaires that were completed by each individual pupil in Appendix F.

During the first semester of this year the student responsible for the execution of the *Mobile Feeding Scheme* business engineering model project, completed the Zulu (ZUL 110) module - presented by the University of Pretoria. The module enabled the student to translate the questionnaire initially generated in English, which was revised by one of the Zulu module tutors and the ArcelorMittal Newcastle works representative. However, the completion of the module assisted the student in communicating with the pupils of Blaauwbosch Primary school, during the frequent visits.

The information obtained through the execution of the relevant fact finding technique, can be viewed within the *concept development* sub-section titled *business engineering model diet*.

3.2.2 Business Engineering Model

The comprehensive *Mobile Feeding Scheme* business engineering model will entail all credentials similar to any other businesses, such as a company trademark (logo) and -slogan (motto). The business model might be more complex, since the final product have to be applicable to all South African schools in need of a feeding scheme over and above a number of potential investors.

All the business functions and components required, in order to ensure the day-to-day functionality of the *Mobile Feeding Scheme*, will be included within the business engineering model. Thus, the following list of functions and components related to the *Mobile Feeding Scheme* project have to be defined and addressed within the design of the business engineering model, in addition to their associated revenues and expenses:

- organisational structure
- development of a balanced diet
- the design of a feasible stationary agricultural garden
- the layout of both a stationary kitchen and mobile kitchen unit
- the supply chain channel to be followed
- all relevant work flow and systems involved
- a procurement schedule
- a feasibility assessment
- the production of the mobile kitchen unit
- all aspects related to the success of daily operational processes
- necessary procedures for the registration of a patent
- the identification of possible stakeholders
- financial considerations
- implementation schedules and procedures
- the registration of a non-profit franchise

The business engineering model is purely demand driven and tend to satisfy the consumer at all cost. The *Mobile Feeding Scheme* business engineering model differs from other models with regard to the fact that it is a non-profit business model, thus the sole purpose of the model does not entail increasing the profit margin using the higher-the-the better principle. The primary objective of the *Mobile Feeding Scheme* business engineering model is to ensure sustainable operations that are focussed on a single, core mission.

Further implementation, once the first iteration of the *Mobile Feeding Scheme* business engineering model is validated at the Blaauwbosch Primary school, would entail periodic reviews and updates of the business engineering model to ensure that the model remains relevant and adaptable to change within the current economic climate and variable consumer demand.

3.2.3 Business Engineering Model diet

As indicated in the *project approach* sub-section of the *Mobile Feeding Scheme* project report, the first step towards the development of the business engineering model requires the establishment of a fixed diet with the help of a dietitian.

The information obtained through the execution of the relevant fact finding technique, the diet currently enforced by the KwaZulu Natal Department of Education, along with the two week cycle diet established by the dietitian, can be viewed within the sub-sections that follow.

1. Information obtained through the completion of the questionnaires

The fact finding technique that was used in order to establish the food preferences of the children attending school at Blaauwbosch Primary, involves the completion of questionnaires. An example of the questionnaire that was completed by each individual, can be viewed in Appendix F. The associated informed consent forms that were signed by the parent or guardian of each pupil under the age of sixteen, can be requested from the student who executed the *Mobile Feeding Scheme* business engineering model project.

The relevant questionnaire was completed by the grade 6- and 7 pupils of the Blaauwbosch Primary school, during the last week of the second school quarter. The data obtained through the completion of the questionnaire was thoroughly analysed by the student. The data revealed by selective questions was denoted using Microsoft Office Excel and can be examined within Figure 28.

The student came to the conclusion that the meals of preference among the children of Blaauwbosch Primary school include red meat, chicken and pizza. The top three fruit types favoured by the pupils consist of apples, bananas and oranges. Lastly, the vegetables preferred by the scholars comprises spinach, carrots and tomatoes.
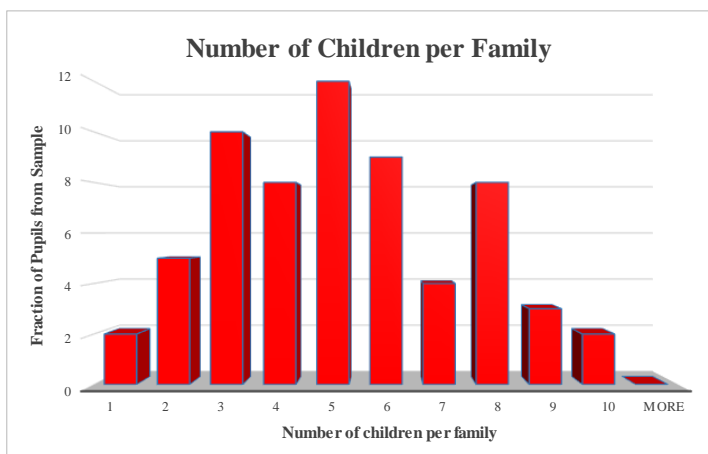
Figure 28A   The number of children per family
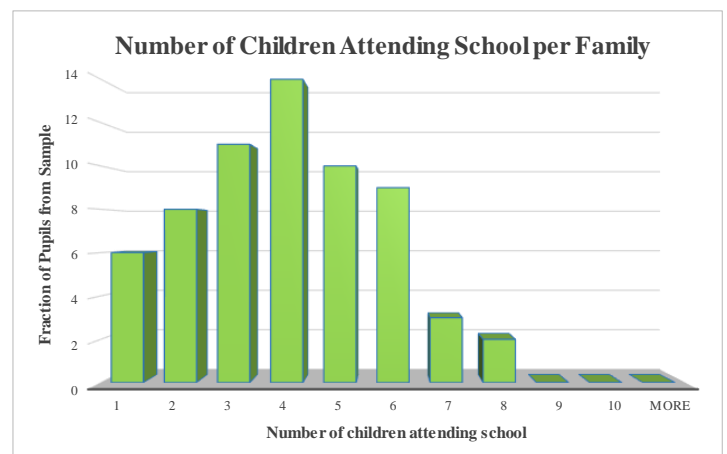
Figure 28B   Number of children attending school per family
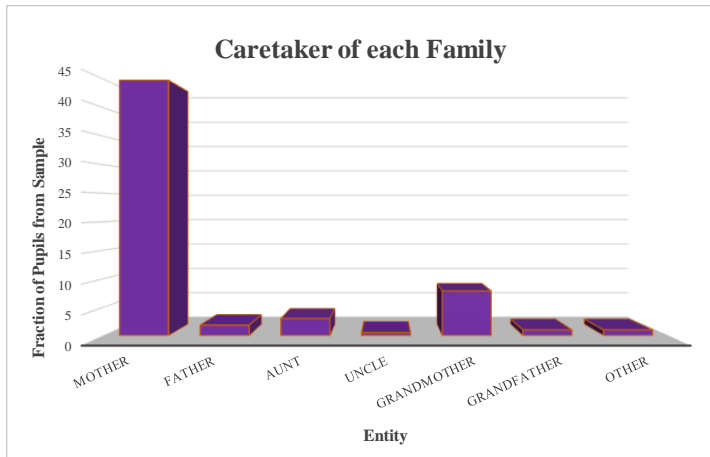
Figure 28C   Caretaker of each family
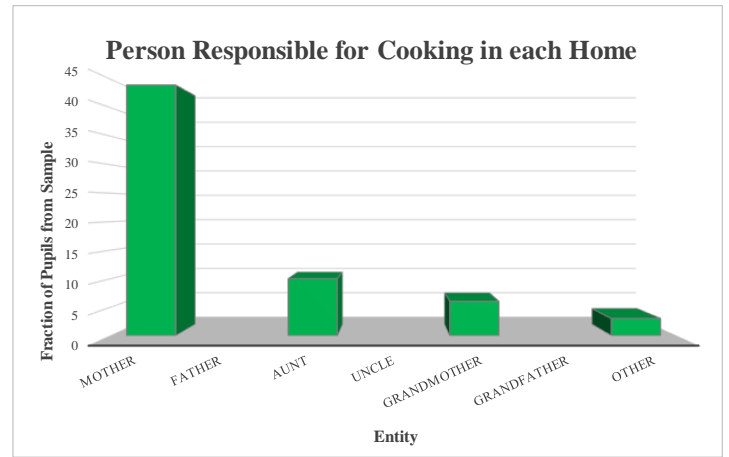
Figure 28D   Person responsible for cooking in each home
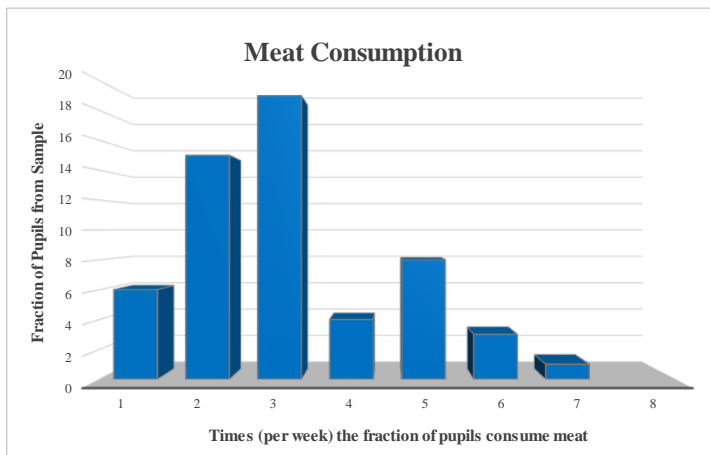
Figure 28E   Meat consumption
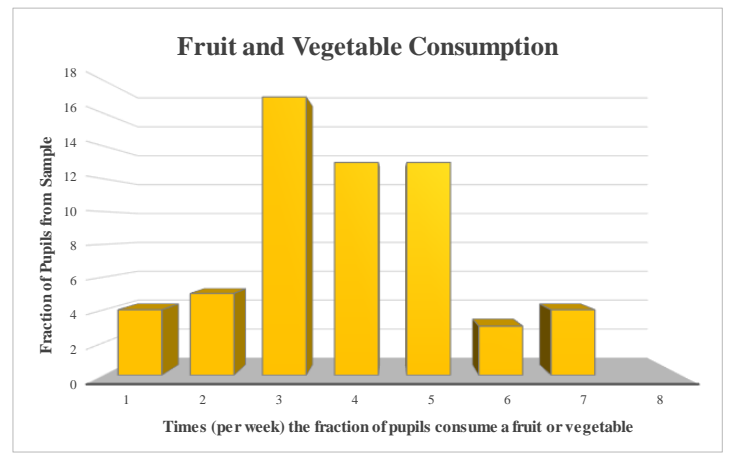
Figure 28F   Fruit and vegetable consumption
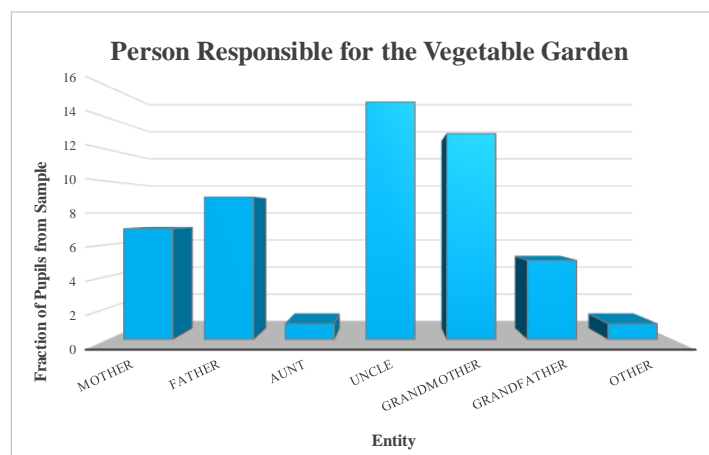
Figure 28G   Person responsible for the vegetable garden

Figure 28 Graphical representations of the data obtained through the completion of questionnaires

The information obtained through the completion of questionnaires, reflected a majority of three children per family, of which four out of the three children is commonly attending school at the given point in time. The fraction of pupils from the sample, with a mother as the principal caretaker of the family is significant. The mother can also be regarded as the common person responsible for the cooking in each home.

With regard to the consumption of specific items it can be noticed that meat is consumed approximately three times per week or less, lastly either a fruit or vegetable type is generally consumed three times a week. During the period in which the student analysed the individual questionnaires, completed by the pupils of Blaauwbosch Primary school, the student noticed that the grade 6- and 7 scholars had difficulty in knowing the difference between fruits and vegetables.

Finally, a question was included within the relevant questionnaire, requesting information with regard to vegetable gardens stationed at the homes of the fraction of pupils in the sample. The number of scholars with vegetable gardens at home, was substantial. The information obtained, indicated that the person responsible for the respective vegetable gardens is primarily the uncle. Thus, the implementation of a stationary agricultural garden through the *Mobile Feeding Scheme* project at the various schools, will surely be beneficial for both the sustainability of the feeding scheme and the education of the pupils.

2. The diet currently enforced by the KwaZulu Natal Department of Education

During the time in which the student was involved mentoring a community based (JCP 210) project at the Sinqobile Combined school earlier this year, the student came across the National School Nutrition Programme menu specifically for primary schools.

The menu provided to each school where the National School Nutrition Programme is implemented, can be viewed within Table 18. The associated menu alternatives, specifications, predetermined substitutes and constraints are listed, along with the National School Nutrition Programme menu.

Table 18 National School Nutrition Programme menu

Day	Food Item	Raw Quantity	Portion Size Served	Energy (kJ)	Protein (g)	Iron (mg)	Calcium (mg)
Monday	soya mince relish (beef flavour)	30g	¾ cup	531	7.3	4.7	63
	boiled rice	50g	1 cup	718	3.23	0.3	17
	braised cabbage/fruit	40g	¼ cup	114	2.7	3.2	122
Tuesday	sugar beans	30g	1 cup	546	6.3	3.9	28.4
	phuthu	70g	1 cup	956	4.88	0.36	24
	carrots	40g	½ cup	114	2.7	3.2	122
Wednesday	canned fish stew	40g	½ cup	546	6.3	3.9	28.4
	boiled rice	50g	1 cup	718	3.23	0.3	17
	braised spinach and tomatoes for fish	70g/10g	¼ cup	130	0.7	0.5	25
Thursday	sugar beans	40g	½ cup	546	6.3	3.9	28.4
	samp	30g	1 cup	956	4.88	0.36	24
	pumpkin/butternut	40g	¼ cup	130	0.7	0.5	25
Friday	canned fish stew/amasi or maas	40g/200ml	½ cup or 1 small cup	297	10.48	1.5	168
	rice/bread phuthu	50g	1 cup or 2 slices	718	3.23	0.3	17
	fresh mixed veg and tomatoes for fish	30g/10g	¼ cup	54	0.7	0.4	28

Alternatives:

Vegetable breyani may be served as an option on Tuesdays. Phuthu and maas to be served as an option on Fridays during the summer months (October to March).

Specifications:

It is important to note that seasoning include iodized salt, pepper, curry powder and thickening agents, with the purpose of improving the taste of the food to be served on all menu options. The specifications for the use of oil is 2 ml, the use of unions is 5 g, and lastly, the use of tomatoes is 5 g. The mentioned specifications is applicable to all menu options with the exception of Wednesdays and Fridays, where an additional 5 g of tomato are required for the fish.

The menu is restricted to the use of only fortified maize meal and flour.

Substitutes:

Pap or maize meal, can be substitute by mashed potatoes, sweet potatoes or madumbes. Pasta may be used to substitute rice.

Constraints:

Bread could only be served once a week, whilst cabbage may not be served more than twice in one week. Fruit (for example apples, bananas, pears or oranges), have to be served at least once a month. Frozen mixed vegetables (such as carrots, or green beans) are restricted to schools with proper refrigeration facilities.

Other:

Safe drinking water to be provided with all meals.

3. The two week cycle diet established by the Dietitian

During the time in which the student conducted research, related to the *Mobile Feeding Scheme* project, the student was informed that the human body is often capable of discontinuing the generation of essential vitamins and minerals, should a fixed diet be repeated each week (every eight days). Thus, the student consulted Ms J. Barnard, a dietitian practicing in Newcastle, specifically requesting the creation of a two week cycle diet.

Table 19 and Table 20 illustrate the two week cycle balanced Tiny Tots Menu developed by the dietitian, Ms J. Barnard. The recipes for each of the dishes required by the Tiny Tots menu, were obtained by the student. The relevant recipes, can be studied within Appendix H.

For the purpose of the *Mobile Feeding Scheme* business engineering model the two week cycle diet will be used to determine the total fixed quantities of the ingredients, which will partially serve as the input for the mathematical model. The mathematical model will be developed and programmed within the sub-sections that follow.

Table 19 Week 1 of Tiny Tots Menu created by J. Barnard

	9:00 **BREAKFAST**	11:00 **OWN SNACK**	13:00 **LUNCH**	15:00 **SNACK**
Week 1				
MONDAY	Maize meal	Snack suggestions given	Chicken & broccoli dish	Bread & jam triangles
TUESDAY	Oats		Spaghetti & mince (with mix veg in mince)	Vegetable soup
WEDNESDAY	Maltabella		Fish cakes with potato wedges	Oranges / fruit in season
THURSDAY	Scrambled eggs with slice of bread		Pap	Kids' warm custard
FRIDAY	Maize meal		Pan pizza	OWN SNACK

Table 20 Week 2 of Tiny Tots Menu created by J. Barnard

	9:00 **BREAKFAST**	11:00 **OWN SNACK**	13:00 **LUNCH**	15:00 **SNACK**
Week 2				
MONDAY	Oats	Snack suggestions given	Tuna pasta bake with peas	Bread & peanut butter triangles
TUESDAY	Maltabella		Minestrone soup with mini breadrolls / bread straws	Apple & spice cupcakes
WEDNESDAY	Soft boiled egg with bread straws		Cottage pie with green bean sticks	Oranges / fruit in season
THURSDAY	Maize meal		Samp and sugar beans with pumpkin	Oats health bars
FRIDAY	Maltabella		Hamburgers	OWN SNACK

The snack suggestions included in the Tiny Tots Menu, can be listed as following:

- Low fat fruit yoghurt (100 g container)
- Frozen yoghurt lollies
- Pieced of fresh fruit
- Tinned fruit in juice (½ cup)
- Fruit salad (½ cup)
- Nuts and raisins (1 tsp of each)
- Fresh bite size veggies
- Homemade microwave popcorn (1 cup)

The *Mobile Feeding Scheme* business engineering model diet will provide the relevant children with breakfast, lunch and a snack at three o'clock in the afternoon. The snack suggestions provided by the dietitian, will be recommended for eleven o'clock, although it is not formally included within the diet applicable to the business engineering model.

3.2.4 Mathematical model

For the purpose of the *Mobile Feeding Scheme* business engineering model, linear programming will be used extensively to solve the complex planning problem. The *Mobile Feeding Scheme* business engineering model problem can be classified as a black-box model with no information given prior to the construction of the mathematical model. The necessary information required for the development of the model can be seen within the relevant *data collection* sub-sections, applicable to the conceptual design phase.

A number of ingredients included within the fixed two week cycle balanced diet, which is directly linked to the *Mobile Feeding Scheme* business engineering model stationary agricultural garden facility, will serve as the input quantities for mathematical model.

As a result, the type of vegetables and crops to plant, the relative amounts of each vegetable- and crop type to plant, over and above when each of the established vegetable- and crop types that has to be planted, will be either prescribed by the two week cycle diet develop by the dietitian, or the literature obtained within the *data collection* sub-section executed as part of the concept development segment.

Consequently, the student intend on using the model to determine the optimal dispersal of vegetable types to be purchased from the local supplier or included within the stationary agricultural garden.

Variables that need to be considered, with regard to the stationary agricultural garden, include the initial cost of each vegetable type, all input related costs (water, fertiliser, etc.), the space- and seasonality requirements of each vegetable type.

The number of children within each school that will benefit from the implementation of the *Mobile Feeding Scheme* project, need to be brought into consideration. Lastly, the remaining product specific prices of the local supplier have to be incorporated, once the optimal solution for the mathematic model is attained.

The new generation optimization software function called *Solver* in Microsoft Office Excel, will be used to solve the input quantities of the real-life *Mobile Feeding Scheme* problem.

3.2.5 Calculation of the geographical optimal location of the stationary facilities

The geographic optimal location of a specific facility can be determined through applying the Centre of Gravity method, which was previously defined within the *tools and techniques* sub-section of the final project report. This method will be repeated for each iteration of the *Mobile Feeding Scheme* business engineering model, in order to calculate the geographical optimal location of the stationary stationary agricultural garden and kitchen facility - with the purpose of minimise travelling time and associated expenses.

In the case of the Blaauwbosch Primary school the Centre of Gravity method will not be applied, since the relevant school already has facilities that are adequate for the location of both the stationary stationary agricultural garden- and kitchen facilities.

Figure 29 below, specifically indicates the location of the Blaauwbosch Primary school and the nearby surrounding schools. The exact coordinates of the Blaauwbosch Primary school is: -27.79053 ; 30.09512 . There are six schools situated within a radius of five kilometres (km) from Blaauwbosch Primary school, that can potentially be serviced by the first iteration of the *Mobile Feeding Scheme* project.
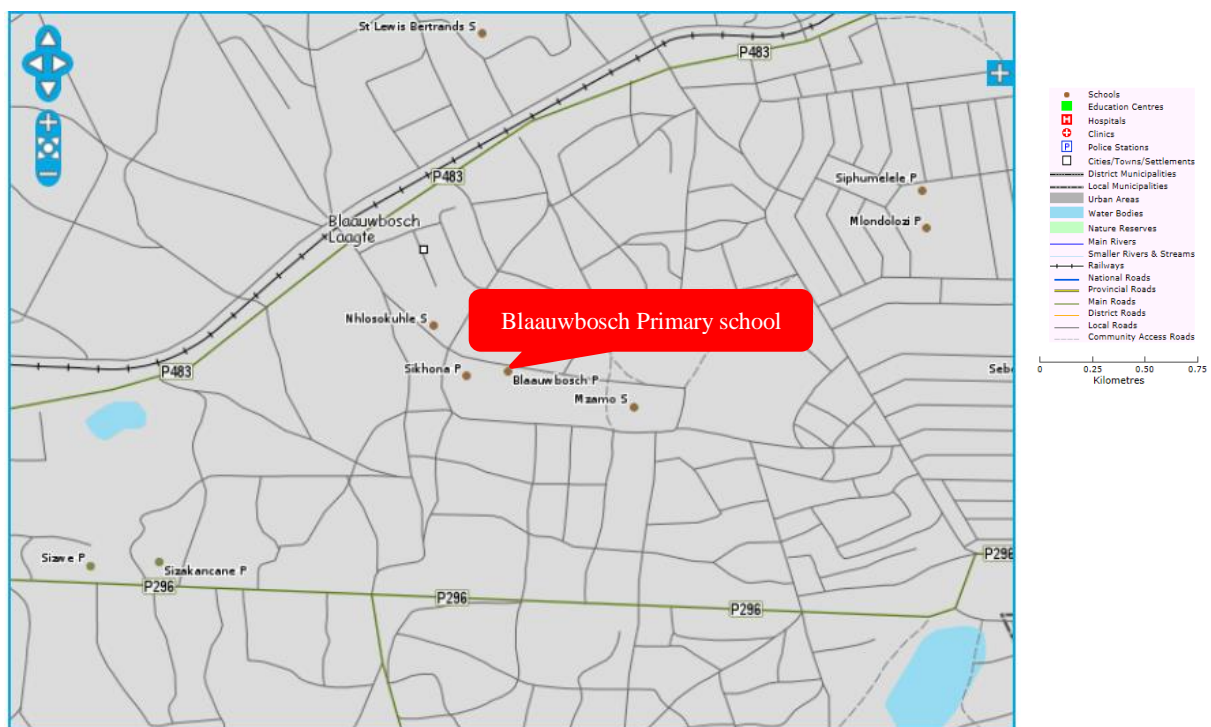
Figure 29 Graphical representation of the Blaauwbosch Primary school located within Osizweni

The six schools situated within a radius of five kilometres (km), which were identified for the purpose of validating the *Mobile Feeding Scheme* business engineering model, include: Blaauwbosch Primary school, Mlondolozi Primary school, Sikhona Primary school and Siphumelele Primary school.

3.2.6 Facilities design

The development of the *Mobile Feeding Scheme* business engineering model entails the design of three facilities, which include the stationary agricultural garden-, the stationary kitchen- and the mobile kitchen unit facility.

For the purpose of the *Mobile Feeding Scheme* project, the student will primarily address the re-design of facilities. The primary reason for considering the re-design of existing structures is mainly due to the fact that schools often have empty buildings or classrooms available for the location of the respective *Mobile Feeding Scheme* stationary kitchen.

The student initially intend to use the Analytic Hierarchy Process (AHP) to establish a favourable layout for the stationary agricultural garden-, the stationary kitchen- and the mobile kitchen unit facility. The student decided against the use of AHP for both the stationary agricultural garden and stationary kitchen, due to the fact that standardised, practical layouts would be preferred. In order to make provision for the future development of the *Mobile Feeding Scheme* business engineering model, a standardised facilities layout will thus be a requirement.

The mobile kitchen unit can however by adjusted to consumer needs, with regard to extras on board of the trailer. The method in which AHP were thus applied, which entails the identification and weight allocation of selection criteria for the specific mobile kitchen unit facility, can be studied within the *concept definition* sub-section. The analysis of the data that was obtained within the literature study of the *Mobile Feeding Scheme* project report, enabled the student to expedite the decision making process with regard to the design of the mobile kitchen unit.

3.2.7 Procurement

The predetermined *Mobile Feeding Scheme* business engineering model two week cycle diet, illustrated in Table 19 and Table 20, will be used to determine the total fixed quantities of the ingredients - required for the production of the final food products.

For the purpose of the first iteration of the *Mobile Feeding Scheme* business engineering model, involving the parent school titled Blaauwbosch Primary and the three secondary schools (Mlondolozi Primary, Sikhona Primary school and Siphumelele Primary school), all dietary ingredients of the Tiny Tots Menu were tabulated in Table 21 and multiplied by the relevant number of pupils that will benefit from the specific iteration of the *Mobile Feeding Scheme*.

The ingredients listed above will primarily by sourced from the nearby situated supermarket, although supplementary economic feasible alternatives may be considered.

Table 21 Total dietary ingredients of Tiny Tots Menu for the first iteration of the business engineering model

List of Ingredients	Total Quantities Required (per person)	Total Quantities Required (two week cycle diet quantities for the first iteration - providing 3 046 children with food)	Units
water	8.58	26144.83	cups
maize meal	1.33	4061.33	cups
salt	0.25	761.50	tsp
quick-cooking oats	1.00	3046.00	cups
matabella	0.50	1523.00	cups
free range eggs	4.00	12184.00	units
milk	0.17	502.59	cups
butter	1.50	4569.00	tsp
bread slices	2.00	6092.00	units
chicken breasts	104.00	316780.13	g
white rice	0.50	1523.00	cups
broccoli	47.33	144177.33	g
milk	0.83	2538.33	cups
velveeta	0.04	115.14	g
mayonnaise	0.14	423.05	cups
pork sausages	50.00	152300.00	g
lean beef mince	83.33	253833.33	g
chopped tomatoe tins	0.33	1015.33	units
egg (medium)	1.08	3299.83	units
courgette	0.17	507.67	units
carrot(s)	0.26	804.65	cups
onion(s)	0.45	1374.93	cups
garlic cloves	1.25	3807.50	units
tomato purée	0.17	507.67	tbsp
parmesan	8.33	25383.33	g
caster suger	30.00	91380.00	ml
oregano	0.17	507.67	tbsp
red wine vinegar	5.00	15230.00	ml
olive oil	0.33	1015.33	tbsp
spagetti	83.33	253833.33	g
water	4.61	14043.63	cups
tuna tins	0.58	1776.83	units
sweet pickle relish	0.33	1015.33	tbsp
Cheddar cheese	0.21	634.58	cups
chicken coating mix	0.25	761.50	pkt
brown sugar	0.25	761.50	tbsp
red pepper	0.06	190.38	tsp
potatoes	2.75	8376.50	units
polenta (mealie pap)	0.25	761.50	cups
salt	2.25	6853.50	tbsp
ready-to-use pizza crust (12")	0.17	507.67	units
original barbecue sauce	0.17	507.67	cups
Mozzarella	0.04	126.92	cups
pineapple	0.04	126.92	cups
green peper	0.18	549.97	cups
Penne Pasta	100.00	304600.00	g
mixed vegetables	0.25	761.50	cups
crackers	0.08	253.83	cups
minestrone soup sackets	1.00	3046.00	units
mini breadrolls/bread straws	2.00	6092.00	units
margarine	15.00	45690.00	g
ground beef	226.80	690821.18	g
vegetable bouillon cube	0.25	761.50	units
peas	0.13	380.75	cups
cornstarch	0.50	1523.00	tbsp
butter	0.67	2030.67	tbsp
green beans tins	0.33	1015.33	units
flour	0.17	507.67	cups
samp	62.50	190375.00	ml
speckled sugar beans	31.25	95187.50	ml
pepper	0.13	380.75	tbsp
oil	1.56	4759.38	ml
mutton neck/lamb	1.50	4569.00	piece
tomato	0.50	1523.00	units
curry powder	1.88	5711.25	ml
turmeric	3.13	9518.75	ml
chicken stock cube	0.13	380.75	units
pumpkin	0.17	507.67	cups
original bisquick mix	0.08	253.83	cups
sugar	0.08	253.83	cups
pumpkin pie spice	0.25	761.50	tbsp
vanilla	0.17	507.67	tbsp
hamburger bun	1.00	3046.00	units
Cheddar cheese slice	1.00	3046.00	units
lettuce	1.00	3046.00	units

3.2.8 Logistics and supply chain

The logistics and supply chain with regard to the of the first iteration of the *Mobile Feeding Scheme* business engineering model involves the procurement of the predetermined selection of items from the closest local supplier of goods and products. The transportation of the goods and products from the relevant supplier, which will be a Shoprite store for the first iteration of the business model, to the Blaauwbosch Primary school - which is regarded as the parent school of the *Mobile Feeding Scheme* project. Thereafter, the preparation of the requested dishes from the delivered goods and products, together with the fresh food products obtained from the stationary agricultural garden follows.

The final food products are directly provided to the children attending school at the Blaauwbosch Primary school, where after the mobile kitchen unit will be used to deliver the final food products to the three nearby situated schools.

The three nearby situated schools that were identified for the purpose of executing the first iteration of the *Mobile Feeding Scheme* business engineering model can be listed as follow:

1. Mlondolozi Primary school
2. Sikhona Primary school
3. Siphumelele Primary school

Figure 30 The Shoprite store located at the Theku Plaza in Osizweni

For the purpose of the first iteration of the *Mobile Feeding Scheme* the *Shoprite* store indicated in Figure 30 on the previous page, was identified. The relevant shop is situated approximately 1.2 kilometres (km) from the Blaauwbosch Primary school and is capable of providing the independent volunteers with all the necessary products for the successful preparation of the *Mobile Feeding Scheme* business engineering model Tiny Tots Menu.

Flow diagrams will be used within the execution of the *engineering design* sub-section of the *Mobile Feeding Scheme* business engineering model project. The diagrams will serve as a pictorial plan representing the flow of work for the stationary facilities. The flow diagrams will indicate both the layout, as well as the location of specific facilities (temporary- and permanent storage areas, inspection stations and working points, etc.). The complete flow diagrams will illustrate movement of material and their direction of flow. Thus, it can be concluded that all work flow and systems involved, will be illustrated by the flow diagrams within the *logistics and supply chain* sub-section of the *engineering development* phase.

3.3   Concept Definition

The *concept definition* sub-section, with regard to the concept development phase of the final project report, entails an in depth investigation of the functional and physical characteristics of the newly proposed system. As previously mentioned, the system referred to is in this case the *Mobile Feeding Scheme* business engineering model. It is of utmost importance that the operational, which was previously defined, is addressed within the respective conceptual designs.

The development of the conceptual designs were purely based on research conveyed within the *data collection* sub-section of the final project report, along with information obtained through interviews with three groups of individuals.

For the purpose of the *Mobile Feeding Scheme* business engineering project, conceptual designs related to the business engineering modelling, the mathematical model, facilities design, and lastly the logistics and supply chain, were developed. Finally, a feasibility assessment were conducted in order to determine whether the relevant conceptual designs included in the *concept definition* sub-section, are economic viable.

3.3.1   Business Engineering Modelling

The section in which the business engineering modelling with regard to the *Mobile Feeding Scheme* business engineering model is addressed, were specifically divided into three main categories. The respective categories include business engineering model branding, business engineering model objective and business engineering model framework. The design of each of the mentioned sub-sections are of utmost importance to define the appearance of the *Mobile Feeding Scheme* business engineering model, the relevant model motives and clearly indicate the business engineering model structure slogan with the associated boundaries.

1.   Business Engineering Model branding

During the first semester of the final year of studies, the student responsible for the execution of the *Mobile Feeding Scheme* business engineering model project obtained a distinction in the module Zulu (ZUL 110) presented by the University of Pretoria. The purpose of completing this particular module was to enable the student to read and write Zulu, since the student was capable of communicating basic sentences in Zulu. During the course of the first semester, the student became acquainted with the Zulu lecturer, Mrs Linda Hall.

With the execution of the final year project proposal, the student decided upon allocating an appropriate Zulu name to the *Mobile Feeding Scheme* business engineering model project. The name will primarily be used as a differentiating tool amongst other feeding schemes in South Africa and since the first iteration of the project will be executed in the Northern KwaZulu Natal region, a Zulu name will be suitable.

Figure 31 *USIZO LOMUSA* **Feeding Scheme business engineering model logo**

The student initially consulted Mrs Linda Hall on the translation of a number of appropriate English names. The name (which will also be used in *Mobile Feeding Scheme* business engineering model logo): ***USIZO LOMUSA* Feeding Scheme** was eventually decided upon, since it imply that *kind assistance* ('vriendelike hulp' in Afrikaans) is offered in the form of a feeding scheme - by people directly involved within the community and stakeholders investing in the project.

Furthermore, student specifically decided upon writing the name of the business engineering model in uppercases, in order to demonstrate the impact of democracy in South Africa, the transformation of inequality and finally, to illustrate parity for all South Africans.

The design of the logo referred to in the previous paragraphs, can be seen within Figure 31. For the purpose of ease the *Mobile Feeding Scheme* business engineering model project will hence forth be referred to as the *USIZO LOMUSA* Feeding Scheme business engineering model project.

The four colourful hands that are associated with the name, represents the four schools that will benefit from the first iteration of the *USIZO LOMUSA* Feeding Scheme business engineering model. Likewise, the different colours used to imprint the hands of the children, symbolises the diversity of people, cultures, languages and schools within South Africa.

The slogan for the *USIZO LOMUSA* Feeding Scheme business engineering model was specifically designed to incorporate the inputs of both people directly involved within the community and external stakeholders investing money instead of time, the theme of hands and lastly, the impact of such a project on the children. Thus, the motto the student decided upon is: *Provide a Hand to put back a Smile.* The exact font and the associated ratio of the font size, with regard to the *USIZO LOMUSA* Feeding Scheme slogan, can be seen within Figure 32.

PROVIDE A HAND TO PUT BACK A SMILE

Figure 32 *USIZO LOMUSA* **Feeding Scheme business engineering model slogan**

2. Business Engineering Model objective

The primary objective of the *USIZO LOMUSA* Feeding Scheme project entails the development of a business engineering model that is capable of providing scholars with a balanced nutritional diet on a daily basis - with the exclusion of weekends, public holidays and school holidays. The business engineering model have to be applicable to all South African schools in need of a feeding scheme (whether it is a stationary- and/or mobile feeding scheme).

The relevant business engineering model consists out of three divisions, which include a stationary agricultural garden at the predetermined primary school, a stationary kitchen facility at the predetermined primary school and lastly, a mobile kitchen unit that will be used to serve the identified nearby situated schools.

The capacity of the business engineering model is restricted to the maximum number of pupils, which is equal to three times the land available for the stationary agricultural garden.

A programmed linear mathematical model will be used to determine the exact input- and the associated quantities of raw materials for the stationary agricultural garden situated at the parent school. The required products that are not included in the stationary agricultural garden inputs, in addition to the mandatory dietary goods, will be sourced from a nearby local supplier.

The stationary kitchen facility situated at the parent school, will be used to prepare of the requested dishes from the delivered goods and products, together with the fresh food products obtained from the stationary agricultural garden. The complete food products will be provided to the children of the parent school, using the stationary kitchen facility.

The last division entails the transportation of the final food products to the relevant neighbouring- or secondary schools, by means of the mobile kitchen unit.

Thus, the business engineering model has to address the procurement of goods and products required by the three previously mentioned division, the associated logistics and supply chain in which the final products are produced, and lastly all operations and support in aid of the relevant business engineering model have to be stated.

Finally, the first iteration of the business engineering model, titled *USIZO LOMUSA* Feeding Scheme, will be validated at the Blaauwbosch Primary school and the three secondary schools: Mlondolozi Primary school, Sikhona Primary school and Siphumelele Primary school.

4. Business Engineering Model framework

The *USIZO LOMUSA* Feeding Scheme business engineering model objective that were previously discussed, were graphically transformed in Figure 33 to clearly illustrate the subsequent stages in the relevant business engineering model framework. The model specific details, associated with the first iteration of the business engineering model, were included in brackets within Figure 33.

USIZO LOMUSA Feeding Scheme

business engineering model

Primary/Parent School

(Blaauwbosch Primary school.)

Secondary Schools

(Mzamo school, Sikhona Primary school, Nhlosokuhle school, Mlondolozi Primary school and Siphumelele Primary school.)

Model specific data indicated in ( )

Stationary Facilities

Agricultural Garden and Kitchen.

Mobile Facilities

Basic Kitchen Unit

Mathematical Model

Fresh Food Products

Procurement

Goods, Products and Schedule

Logistics and Supply Chain

Goods, Raw Products and Final Food Products

Production

Final Food Products

Model operating boundaries

Operations and Support

Business Engineering Model

Additional, supporting documentation and specifications

Figure 33 *USIZO LOMUSA* **Feeding Scheme business engineering model framework**

3.3.2 Mathematical Model – linear programming using Microsoft Office Excel

For the purpose of successfully developing the *USIZO LOMUSA* Feeding Scheme business engineering model, the student constructed a mathematical model using the linear programming method that was previously discussed.

The mathematical model will enable the relevant business engineering model user(s) to determine the optimal distribution of vegetable types that need to be purchased from the local supplier and/or included within the stationary agricultural garden. Thus, the mathematical model will be used to solve the input quantities of the real-life *USIZO LOMUSA* Feeding Scheme problem.

All relevant assumptions, the definition of sets, required parameters, the objective function constants, decision variables, the objective function and the associated subjective constrains can be studied within the sub-sections that follow.

Finally, the linear mathematical model were programmed using the new generation optimization software function called *Solver* in Microsoft Office Excel. The preliminary results can be viewed within the last sub-section of the *mathematical model – linear programming using Microsoft Office Excel* sub-section.

The result obtained by the mathematical model at this point in time is incorrect, due to the fact that the student is currently in the process of negotiating with the relevant Shoprite store. The student would like to settle on a price that is favourable for both parties, since the business engineering model will be implemented within the nearby future. Once negotiates has reached consensus, the relevant amounts will be inserted into both the mathematical model and the cost estimate financial consideration table included in the *conclusive considerations* section.

4.1 Assumptions

Assumptions that were made with regard to the *USIZO LOMUSA* Feeding Scheme business engineering model, include:

1. The stationary agricultural garden is watered by a permanent employee, who is responsible for the maintenance of the specific school and is paid by the relevant school. Else it is the responsibility of the voluntary individuals to water the stationary agricultural garden.

2. One voluntary individual is allocated to every two hundred (200) children that need to be provided with food. The total obtained, have to be rounded to the closest round number.

3. No inventory is kept on hand at this point in time. The model could however be modified at a later stage, to incorporate inventory levels.

4.2 Set defined

Set of products $i \in \bar{I} =$

1 =		broccoli
2 =		carrot
3 =		green beens
4 =		green pepper
5 =		lettuce
6 =		onion
7 =		peas
8 =		potatoes
9 =		pumpkin
10 =		red pepper
11 =		relish
12 =		sugar beans
13 =		tomato

4.3 Parameters

d_i $\triangleq$ the given annual demand (in units) for product $i \in \bar{I}$.

c_i $\triangleq$ the given varying market price (in ZAR) for product $i \in \bar{I}$.

g_i $\triangleq$ the calculated input cost (in ZAR) for product $i \in \bar{I}$.

w_i $\triangleq$ the given amount (in litres) of water required for product $i \in \bar{I}$.

m_i $\triangleq$ the given space requirements (in m^2) for product $i \in \bar{I}$.

a_i $\triangleq$ the given price (in ZAR) of the seedlings required for product $i \in \bar{I}$.

f_i $\triangleq$ the given cost (in ZAR) associated with fertilising product $i \in \bar{I}$.

x_i $\triangleq$ the annual quantity/amount (in kg) to purchase, of product $i \in \bar{I}$.

4.4 Objective function constants

n   ≜   the given number of children to be included within the *USIZO LOMUSA* Feeding Scheme business engineering model.

s   ≜   the given annual salary (in ZAR) to be paid to the individuals volunteered by the community, to assist with the execution of the *USIZO LOMUSA* Feeding Scheme business engineering model.

l   ≜   the given land (in m^2) available for the use of the *USIZO LOMUSA* Feeding Scheme business engineering model.

b   ≜   the summation of the annual salary (in ZAR) to be paid to the relevant number of individuals involved in the execution of the *USIZO LOMUSA* Feeding Scheme business engineering model.

NOTE:

$$b = \text{ROUND}(\frac{sn}{200})$$

4.5 Decision Variable

p$_i$ ≜   the calculated optimal price (in ZAR) to be paid for product $i \in \bar{I}$.

4.6 Objective function

$$\min z = 26n \left[\sum_{i \in \bar{I}} d_i(p_i) \right] + b$$

4.7 Subjective constraints

If $c_i \leq g_i$ then $p_i = c_i$

If $g_i < c_i$ then $p_i = g_i$
     method used to calculated optimal price of products $i \in \bar{I}$.

$$\sum_{i \in \bar{I}} m_i \leq l$$ land constraint

$$w_i \leq \sum_{i \in \bar{I}} w_i$$ water constraint

$$\sum_{i \in \bar{I}} d_i \leq n \sum_{i \in \bar{I}} d_i$$ demand constraint

$$g_i = a_i + f_i + w_i$$ input cost calculation and constraint

4.7 Mathematical model programmed using Microsoft Office Excel

USIZO LOMUSA Feeding Scheme Business Engineering Model

Mathmatical Model:

Parameters

Set of Products $i \in \Gamma$

1 =		broccoli
2 =		carrots
3 =		green beans
4 =		green pepper
5 =		lettuce
6 =		onion
7 =		peas
8 =		potatoes
9 =		pumpkin
10 =		red pepper
11 =		relish
12 =		sugar beans
13 =		tomato

Decision Variables

	Di (in kg)	Ci (in ZAR/kg)	Gi (in ZAR/kg)	Pi (in ZAR)	Wi (in liters)	Mi (in m^2)	Ai (in ZAR/seed)	Fi (in ZAR/unit)
1 =	144.18	6.99	8.99	0.00	7.99	18.00	16.99	30.00
2 =	33.53	5.00	3.99	3.99	7.99	300.00	16.99	30.00
3 =	507.67	3.99	4.30	3.99	7.99	50.00	16.99	30.00
4 =	137.49	24.99	29.99	24.99	7.99	2.00	16.99	30.00
5 =	1523.00	12.99	10.95	10.95	7.99	6.00	16.99	30.00
6 =	171.87	11.99	10.00	0.00	7.99	15.00	16.99	30.00
i 7 =	95.19	4.95	5.20	0.00	7.99	40.00	16.99	30.00
8 =	4188.25	19.99	24.00	19.99	7.99	15.00	16.99	30.00
9 =	126.92	8.99	7.55	7.55	7.99	2.00	16.99	30.00
10 =	76.15	69.99	75.99	52.44	7.99	2.00	16.99	30.00
11 =	406.13	6.99	7.50	0.00	7.99	12.00	16.99	30.00
12 =	95.19	4.99	4.99	0.00	7.99	45.00	16.99	30.00
13 =	609.20	10.00	12.00	0.00	7.99	15.00	16.99	30.00

Colour Representation: | Purchase | Plant |

Objective Function Constants

N =	3046	pupils
S =	R 1 629.16	in ZAR per year
L =	1932	in square meters
B =	26066.54613	in ZAR per year

Objective function value   **Z =**   **8786538571**

Subject Constraints

	LH		RH		LH		RH	
1	6.99	equals	0		6.99	equals	0	
2	3.99	equals	4		3.99	equals	4	
3	3.99	equals	4		3.99	equals	4	
4	24.99	equals	25		24.99	equals	25	
5	10.95	equals	11		10.95	equals	11	
6	10	equals	0		10	equals	0	
7	4.95	equals	0		4.95	equals	0	
8	19.99	equals	20		19.99	equals	20	
9	7.55	equals	8		7.55	equals	8	
10	69.99	equals	52		69.99	equals	52	
11	6.99	equals	0		6.99	equals	0	
12	4.99	equals	0		4.99	equals	0	
13	10	equals	0		10	equals	0	
14	1932	<=	1932	(land/ground constraint)				
15	0	<=	989.92105					
16	31.8801	<=	989.92105					
17	31.8801	<=	989.92105					
18	199.6701	<=	989.92105					
19	87.4905	<=	989.92105					
20	0	<=	989.92105					
21	0	<=	989.92105	(water constraint)				
22	159.7201	<=	989.92105					
23	60.3245	<=	989.92105					
24	418.95565	<=	989.92105					
25	0	<=	989.92105					
26	0	<=	989.92105					
27	0	<=	989.92105					
28	0	<=	110946.4178					
29	133.7733396	<=	110946.4178					
30	2025.59	<=	110946.4178					
31	3435.940886	<=	110946.4178					
32	16676.85	<=	110946.4178					
33	0	<=	110946.4178					
34	0	<=	110946.4178	(demand constraint)				
35	83723.1175	<=	110946.4178					
36	958.2208333	<=	110946.4178					
37	3992.92525	<=	110946.4178					
38	0	<=	110946.4178					
39	0	<=	110946.4178					
40	0	<=	110946.4178					
41	0	>=	144					
42	4	>=	34					
43	4	>=	508					
44	25	>=	137					
45	11	>=	1523					
46	0	>=	172					
47	0	>=	95	(variable constraints)				
48	20	>=	4188					
49	8	>=	127					
50	52	>=	76					
51	0	>=	406					
52	0	>=	95					
53	0	>=	609					

Figure 34 *USIZO LOMUSA* **Feeding Scheme business engineering mathematical model**

3.3.3 Facilities Design

1. Stationary agricultural garden layout

For the purpose of designing a stationary agricultural garden layout, with regard to the first iteration of the *USIZO LOMUSA* Feeding Scheme business engineering model, the unutilized land at the Blaauwbosh Primary school had to be investigated. Figure 2, included within the *Mobile Feeding Scheme* business engineering model background, is a pictorial representation of the unutilized land.

During the first accompanied visit to the Blaauwbosch Primary school at the beginning of this year, an attempt of a vegetable garden generated by the three responsible individuals were observed. A schematic representation of the original arrangement of the partial utilized land, can be viewed within Figure 36 on the subsequent page. The temporary vegetable garden developed by the three independent volunteers, was not properly fenced at that point in time and both the JoJo tanks were unoccupied.

Remarkable improvement with regard to the unutilised land at Blaauwbosch Primary school could already be noticed, during the month of August. The project sponsor, ArcelorMittal Newcastle works, indirectly assisted the pupils of Blaauwbosch Primary school with a temporary vegetable garden that can be viewed in Figure 35. The work was performed during the sixty seven (67) minutes dedicated to Nelson Mandela on the 19th of July 2014.

Both the original and supplementary unutilised land were fenced, in addition to the complete installation of the two JoJo tanks. Furthermore, several vegetable types were already embedded in the newly created beds, using a stick with a piece of plastic to indicate the exact location of the individual plants - before the seedlings evolve. An updated layout of the utilized land arrangement, can be observed in Figure 37.

Figure 35 Picture illustrating the progress already made at the Blaauwbosch Primary school
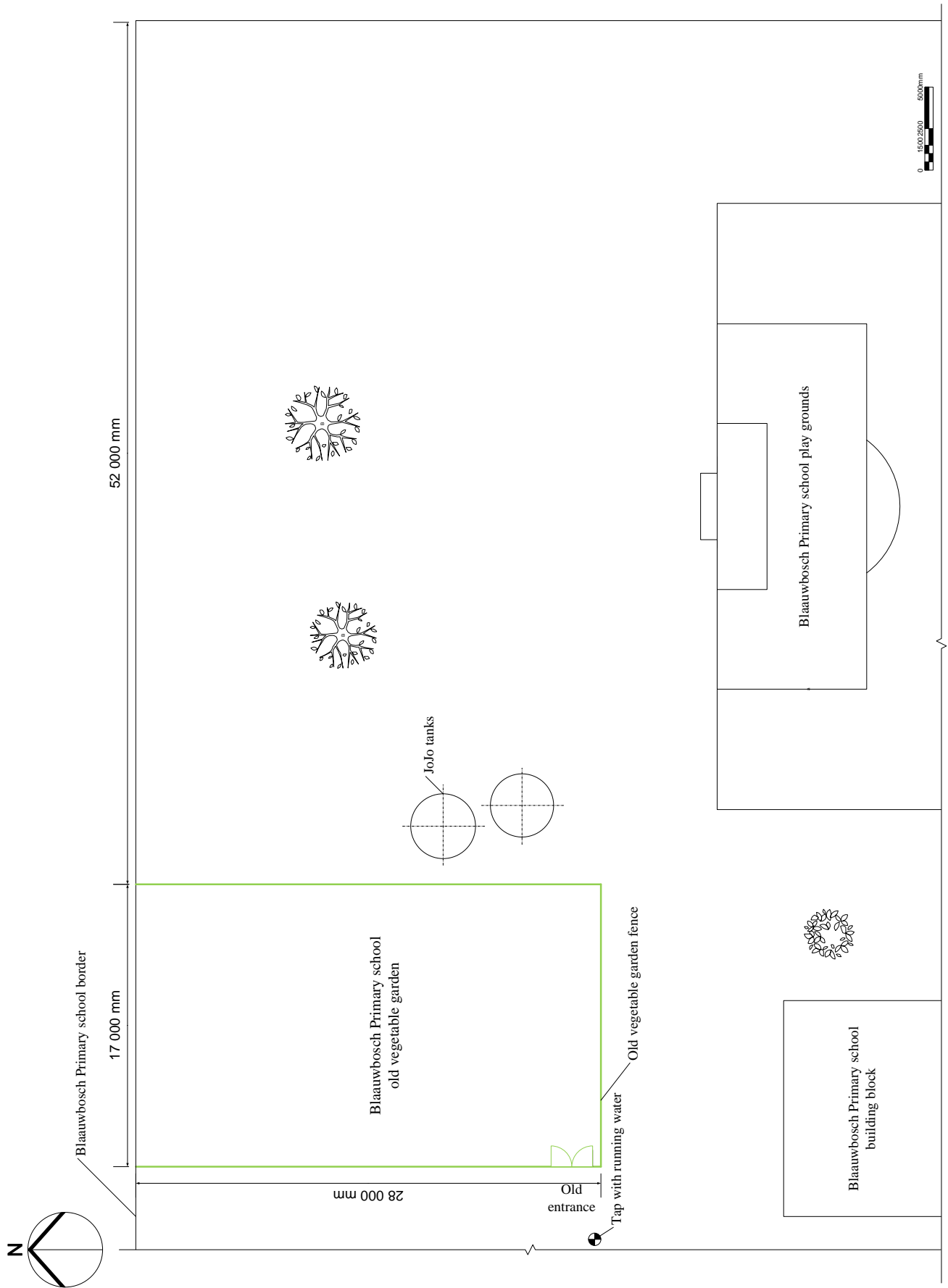
Figure 36 The Blaauwbosch Primary school original arrangement of the utilized land
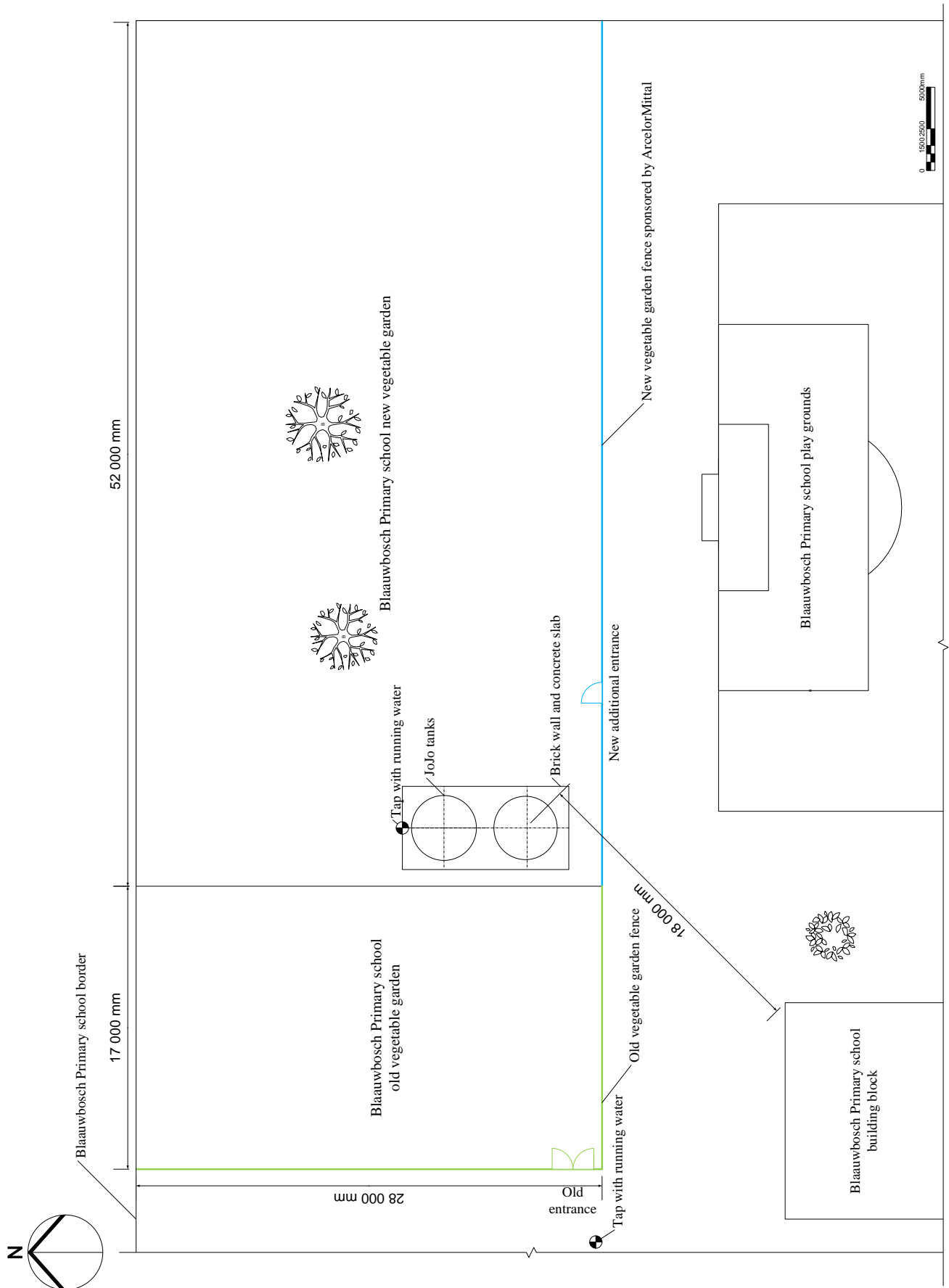
Figure 37 Updated arrangement of the Blaauwbosch Primary utilized land

For the purpose of the *USIZO LOMUSA* Feeding Scheme business engineering model, a standardised, practical layout for the stationary agricultural garden is advised. The stationary agricultural garden layout will be designed using the facilities planning principles, in addition to lean manufacturing principles, that were researched within the *literature review* section of the final year project report.

The specific stationary agricultural garden design, illustrated in the *advance development* sub-section of the *phase II – engineering development* sub-section, will serve as a guideline for the generation of a stationary agricultural garden layout applicable to all South African schools. Thus, the standardised layout specifically designed for the first iteration of the *USIZO LOMUSA* Feeding Scheme business engineering model, can be adjusted to fit the particular need of the supplementary schools.

The proposed layout of the stationary agricultural garden, related to the *USIZO LOMUSA* Feeding Scheme business engineering model, will be implemented at the Blaauwbosch Primary school on the completion of the final year project.

2. Stationary kitchen layout

The *USIZO LOMUSA* Feeding Scheme business engineering model requires the location of the stationary kitchen facility at the parent school, along with the static stationary agricultural garden. The fixed kitchen facility will be used to prepare of the requested dishes from the purchased goods and products, together with the fresh food products obtained from the stationary stationary agricultural garden.

Similar to the static stationary agricultural garden, a practical, standardised layout for the stationary kitchen facility is recommended to enable the future expansion of the *USIZO LOMUSA* business engineering model at several South African schools in need of a feeding scheme (stationary- and/or mobile). The facilities planning principles, along with the lean manufacturing principles that were researched within the *literature review* section of the final year project report, will once again be used for the design of the stationary kitchen facility.

The student will address the re-design of facilities, for the purpose of the *USIZO LOMUSA* Feeding Scheme business engineering model. The reason for primarily addressing the re-design of facilities, is due to the fact that the Blaauwbosch Primary school (along with several other schools) often have unoccupied buildings and/or classrooms available for the respective *USIZO LOMUSA* Feeding Scheme stationary kitchens.

The existing stationary kitchen facility at the Blaauwbosch Primary school, which is currently used for the government implemented National School Nutrition Programme, will be re-designed for the purpose of the first iteration of the *USIZO LOMUSA* Feeding Scheme business engineering model. The floor plan of the current stationary kitchen facility, can be studied within Figure 38 on the subsequent page.

The practical stationary kitchen facility design included in the of the *advance development* sub-section of the *phase II – engineering development* sub-section, will once again serve as a guideline for the future expansion of the *USIZO LOMUSA* Feeding Scheme business engineering model. However, alterations can be made to the standardised design, to incorporate the specific needs of supplementary schools.

It is important to note that the execution of the first iteration at the Blaauwbosch Primary school, including the three neighbouring schools, will serve as the validation of the relevant business engineering model. Thus, the stationary kitchen facility design is subject to change.
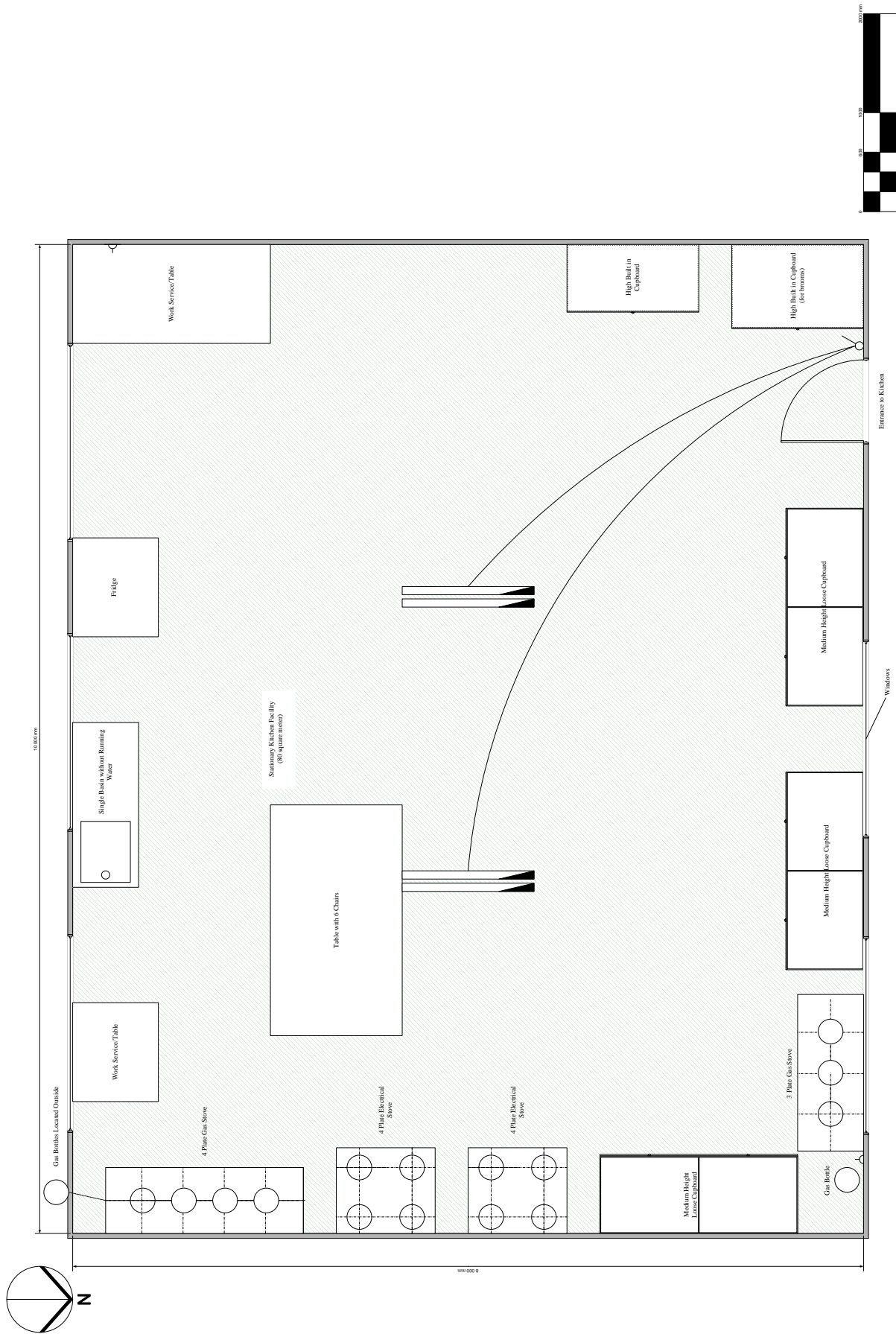
Figure 38 Floor plan of the current stationary kitchen facility at the Blaauwbosch primary school

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3. Mobile kitchen unit

The *USIZO LOMUSA* Feeding Scheme business engineering model requires the design of a mobile kitchen unit that is capable of carrying of the final food products to the relevant neighbouring- or secondary schools included in the specific business engineering model.

The following sub-sections entail a thorough AHP analysis with regard to the requested mobile kitchen unit, in conjunction with the conceptual design of the specific unit.

3.1   AHP analysis

Due to the fact that the design of the mobile kitchen unit can be adjusted according to consumer needs, the student decided upon using AHP analysis in order to establish the preferred arrangement through equal opportunity layout selection. The AHP analysis will be used to enforce a decision between three conceptual design alternatives, namely layout A, -B and -C that can be observed within the following sub-section - categorised accordingly. The main criterion (also referred to as the selection criteria) that were identified for the execution of the AHP analysis, include the following pairwise comparisons: advanced, practicality, price and spacious.

The main criterion titled advanced, entails the possible incorporation of extra features on board the mobile kitchen unit trailer such as mobile water purification equipment, internet access and airtime procurement facilities. However, the possibility of only having a mobile kitchen unit with no additional features also exists.

The second main criterion mentioned, primarily involves the practicality of the layout. The acknowledgement of appropriate work surfaces, sufficient aisle space, ergonomic working environment considerations, the availability of relevant fixed equipment and tools, the incorporation of sliding windowpanes, and so forth.

The price of the mobile kitchen unit is included in the main criterion for the AHP analysis, due to the fact that it is without a doubt a pairwise comparison related to both the main criterion: advanced and spacious. Thus, trade-offs have to be made in order to ultimately obtain an economic feasible solution, with regard to the *USIZO LOMUSA* Feeding Scheme business engineering model.

The main criterion spacious was selected based on the fact that space is capable of directly influencing productivity. Furthermore, the previously discussed main criterion titled price, will causes an assertive contrasting action in the opposite direction of the spacious main criterion. A favourable increase in space on board the mobile kitchen unit, would imply an unfavourable increase in the price.

The respective conceptual mobile kitchen unit layouts will be briefly discussed within the following sub-section, prior to the methodical consideration of the AHP analysis.

3.2 Conceptual layouts of the mobile kitchen unit

The conceptual designs of the three alternative layouts related to the mobile kitchen unit can be viewed within Figure 39, Figure 40 and Figure 41. The three respective designs include the following fixed interior equipment and properties: open base work surfaces with shelf's, a gas stove with two plates, a X kilogram gas bottle, one X litre fridge, one double wall mounted plug and lastly, a single florescent tube light fitting mounted in the ceiling of the mobile kitchen unit. Each alternative will be briefly discussed within the sub-sections that follow, with regard to the main criterion identified.

Layout A:
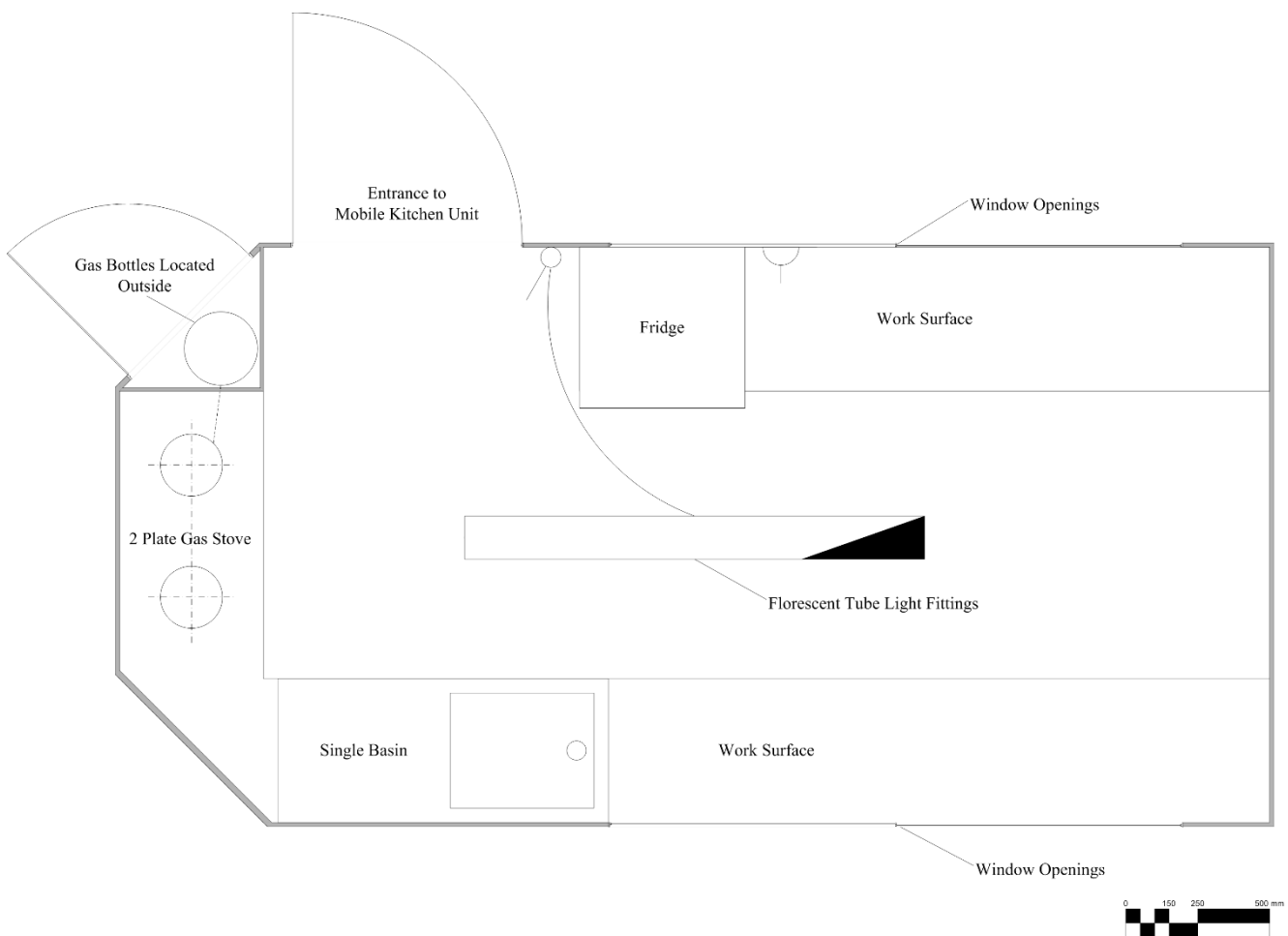
Figure 39 Conceptual design representing Layout A of the mobile kitchen unit

Layout A entails an advanced conceptual design with a possibility of including mobile water purification equipment, along with airtime procurement facilities on board the mobile kitchen unit. The incorporation of possible advanced features is primarily due to the availability of excess space, although Layout C can be regarded as the design with the most unutilised space. For the purpose of the *USIZO LOMUSA* Feeding Scheme business engineering model, Layout A can be regarded as practical - although the practicality factor most definitely has cost implications.

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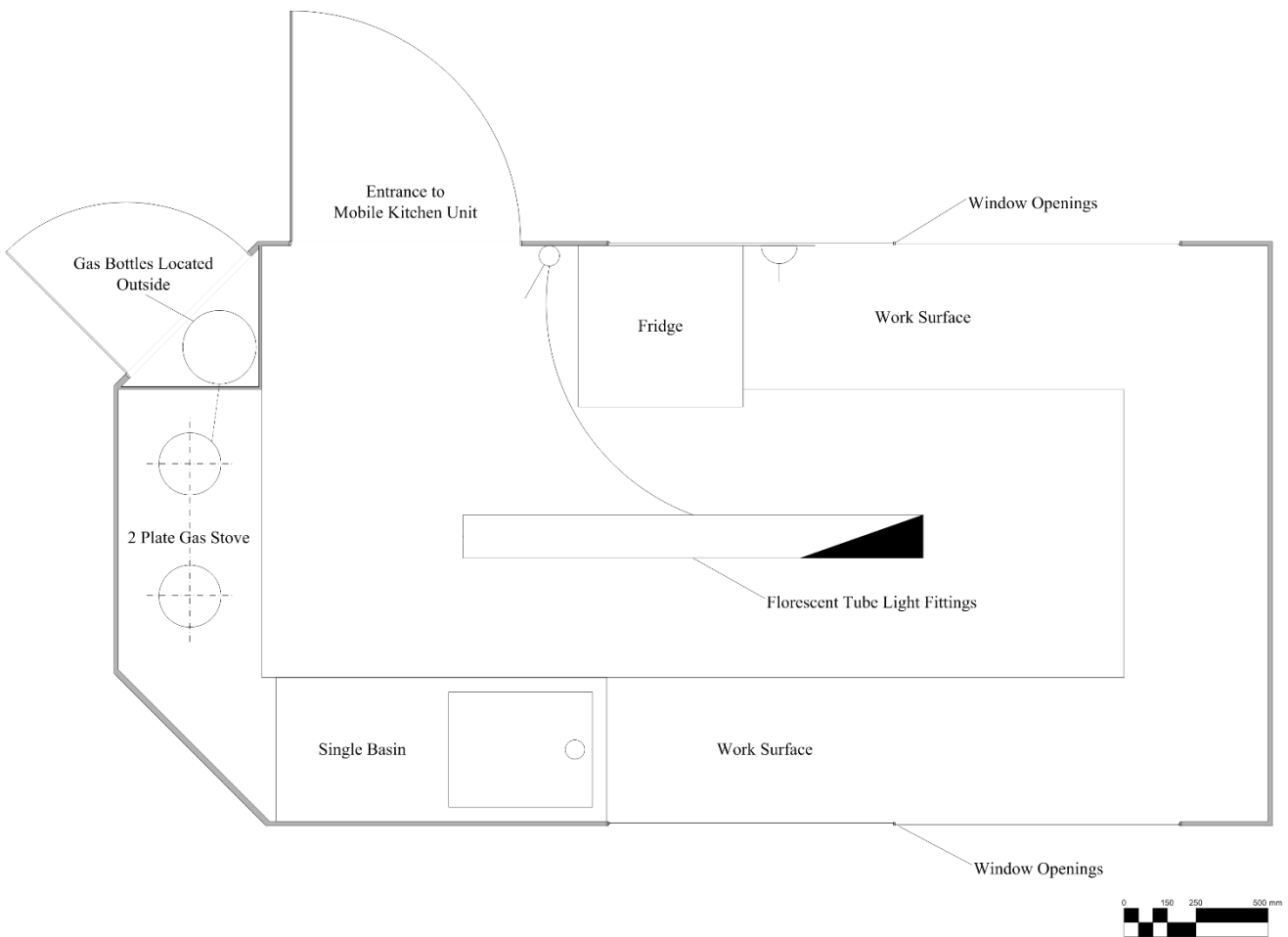
Layout B:

Figure 40 Conceptual design representing Layout B of the mobile kitchen unit

The additional work surface in layout B is the primary difference, when compared to Layout A. Thus, it would imply that this specific conceptual design is less spacious. The possibility of including mobile water purification equipment will therefore not be considered, although the airtime procurement feature will be incorporated in the design. Layout B can be regarded as less practical than Layout A since a decrease in space bears the risk of causing a decrease in productivity, whilst the extra work surface might come handy. The price associated with Layout B will surely be greater than that of Layout A, due to the addition of a supplementary work surface.

Layout C:
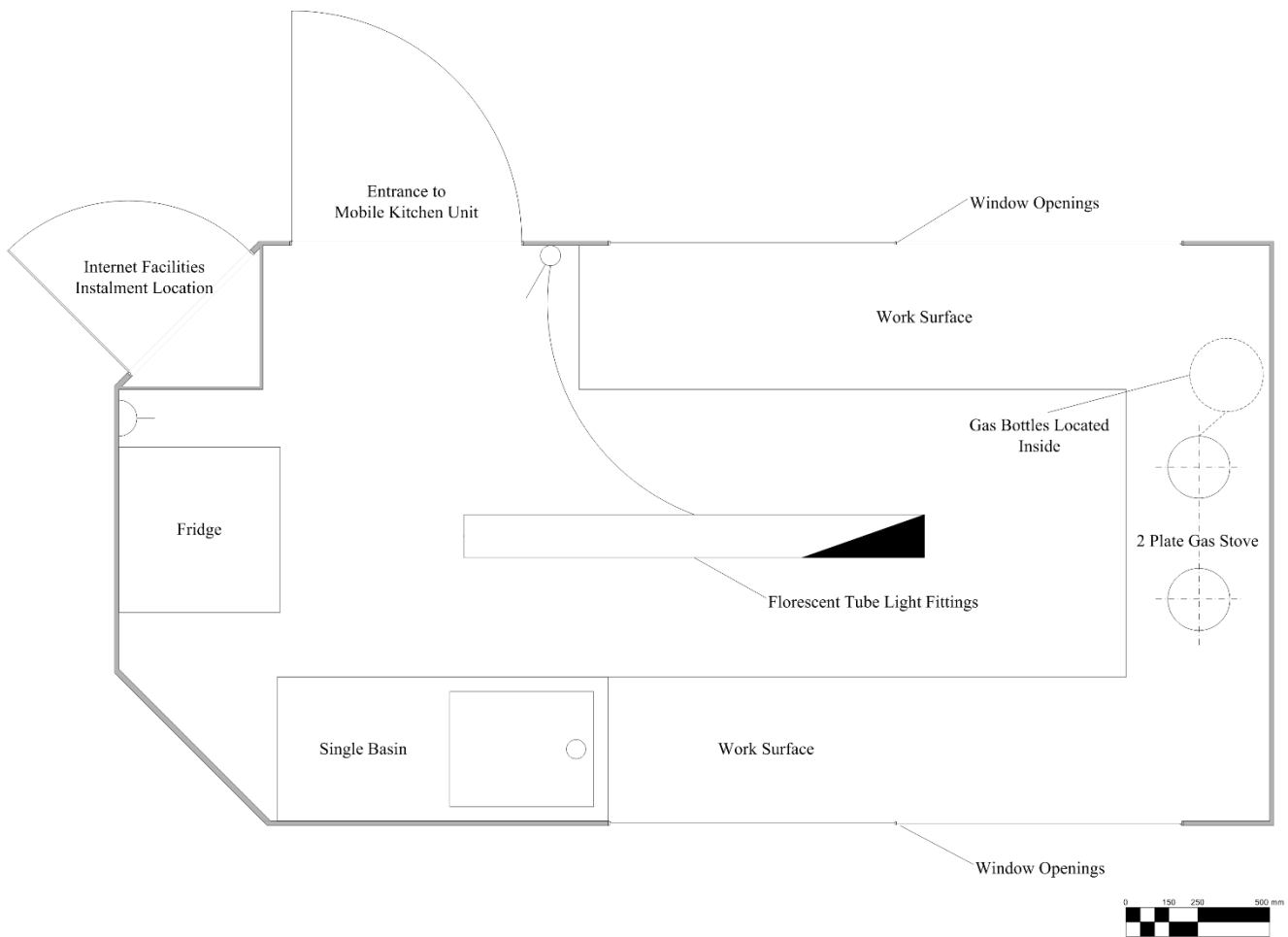
Figure 41 Conceptual design representing Layout C of the mobile kitchen unit

When Layout C is compared to the conceptual designs of both Layout A and Layout B, it can be noticed that this particular layout contains more excess space than both of the two previous discussed layouts. Thus, the addition of all three researched features can be considered (the mobile water purification equipment, airtime procurement facilities, in addition to the convenience of internet access). Concerning the practicality of this particular design, the student commented that the addition of the specific features might influence the efficiency of the relevant employees operating in Layout C. It can be concluded that the price related to the supplementary features and the re-structuring of the mobile kitchen unit interior, will most probably be equal to the price of Layout B.

For the purpose of executing the AHP analysis, the relevant student made use of the Multi-Criteria, Multi-Alternative Decision Making Analytic Hierarchy Process Template, generated by Prof P.S. Kruger during the course of the *Industrial Analysis* (BAN 313) module.

The primary objective of AHP analysis involves the consideration of all possible outcomes, related to the process in which equal opportunity layout selection has to be applied. During the period in which the relevant student conducted research related to AHP analysis, numerous steps were identified for the successful execution of this specific technique.

The first step required the decomposition of the primary objective into constituent parts that are referred to as main criterion. The second step included the sub-division of a set of alternatives, which is the respective layouts in this case. Both the first- and second steps, were addressed within the introductory paragraphs of the *mobile kitchen unit* sub-section.

A graphical illustration of the relevant primary objective, with regard to the selection of the layout of preference for the *USIZO LOMUSA* Feeding Scheme mobile kitchen unit can be examined within Figure 42.
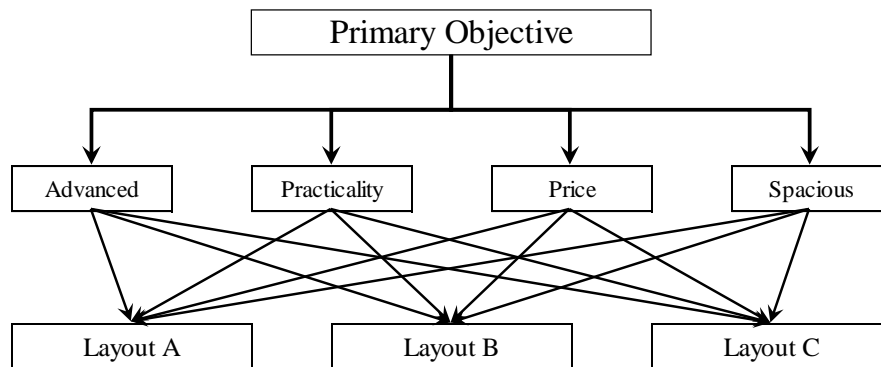
Figure 42 The primary objective of the AHP analysis related to the *USIZO LOMUSA* Feeding Scheme

Thereafter relative weights were assigned to each of the identified main criterion, using the value scale provided in Table 22, during the third step. The respective weights allocated on the scale of one to nine, can be seen within Figure 43. It is important to note that the sum each tier, for all the main criterion included in the primary objective, have to be equal to the value of one.

Table 22 AHP analysis value scale

Number	Denotation on Value Scale
1	Objectives i and j are of equal importance
3	Objectives i is weakly more important than objective j
5	Objectives i is strongly more important than objective j
7	Objectives i is very strongly more important than objective j
9	Objectives i is absolutely more important than objective j
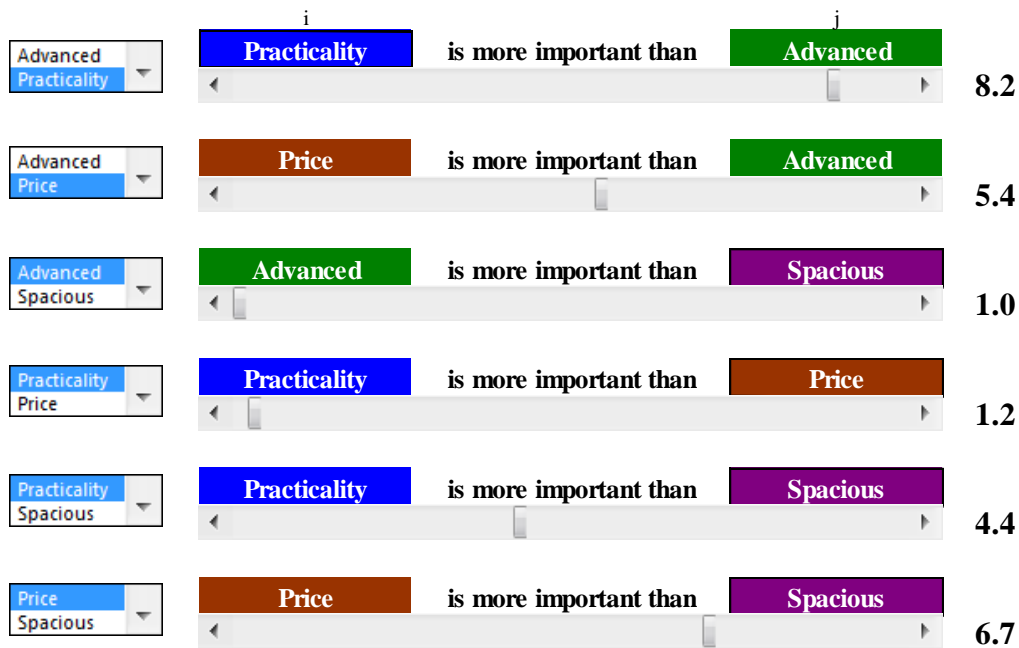
Figure 43 Relative weights assigned to each of the identified main criterion

The final step of the AHP analysis, required the comparison of the numerous choice scorings on a relative basis. The relevant scores had to be calculated within the individual leafs of the hierarchy model. Thereafter, the summed scores were used to generate the result, yielding a composite score for each row choice, over and above an overall score.

The AHP analysis main criterion comparison matrix, along with the relevant scores calculated within the individual main criterion segments of the hierarchy model, were included within Appendix I of the final project report. The results produced through the summation of the respective scores in the objective hierarchy, in addition to the overall score of the final relative weights, can be viewed within Figure 44 and Figure 45 on the subsequent page.

Figure 44 clearly indicates that Layout C is favoured with regard to the main criterion titled spacious and entails the addition of advanced features. Layout A is highly recommended for the purpose of practicality and price. Furthermore, Figure 44 illustrates that the two main criterion: practicality and price, play an enormous role in the decision making process related to the equal opportunity layout selection.

Finally, Figure 45 demonstrates the concluding results obtained through the execution of the AHP analysis, with regard to layout of the *USIZO LOMUSA* Feeding Scheme mobile kitchen unit. Layout A was identified as the layout of preference for the mobile kitchen unit of the *USIZO LOMUSA* Feeding Scheme business engineering model project.

Primary Objective

Advanced	Practicality	Consistency Index CI / RI	Price	Spacious
0.0673	0.4483	0.0199	0.4085	0.0759

Layout A	Layout A	Layout A	Layout A
0.2605	0.6333	0.6000	0.2605
Layout B	Layout B	Layout B	Layout B
0.1062	0.1062	0.2000	0.1062
Layout C	Layout C	Layout C	Layout C
0.6333	0.2605	0.2000	0.6333
CI / RI =	CI / RI =	CI / RI =	CI / RI =
0.0334	0.0334	0.0000	0.0334
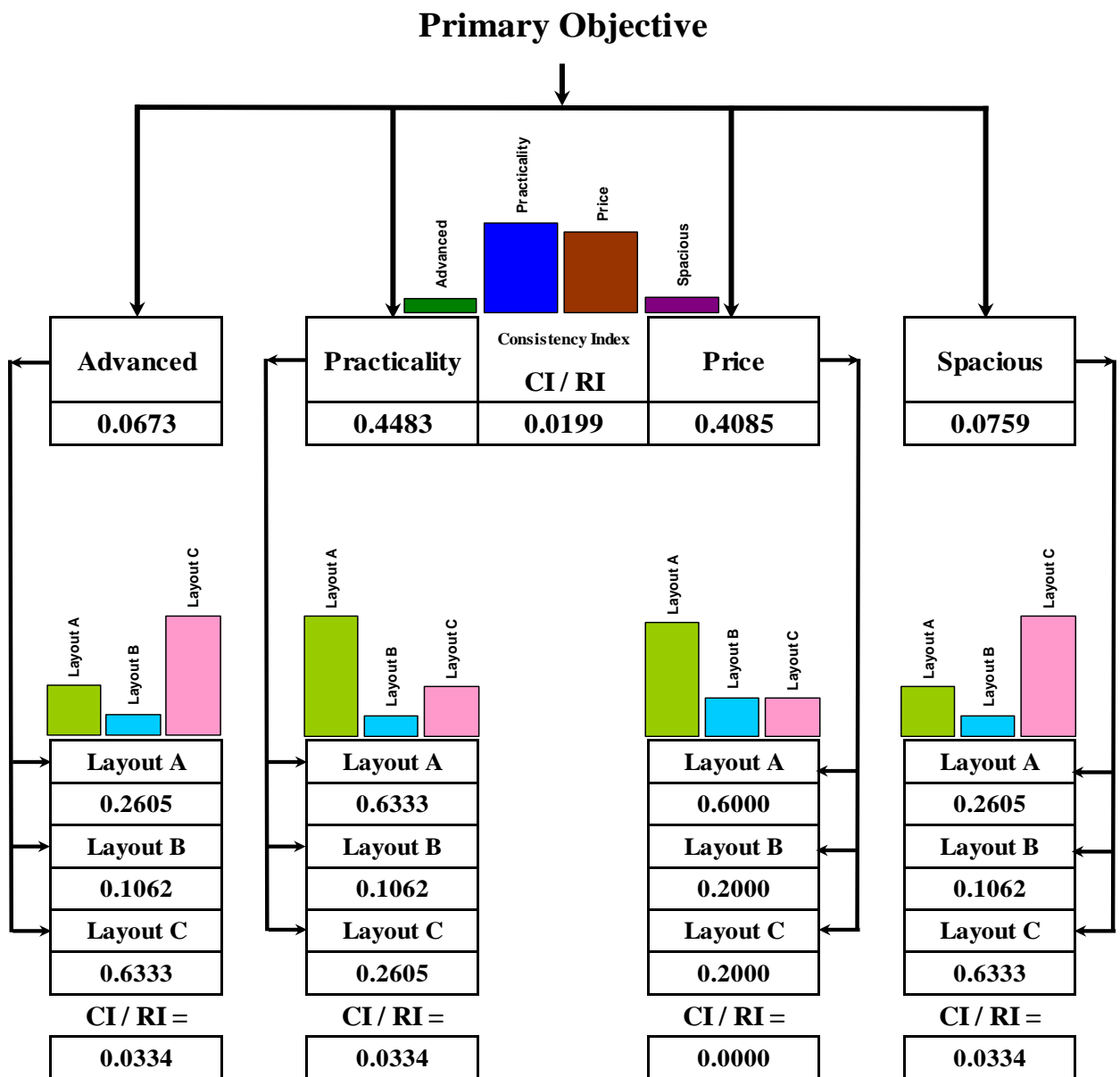
Figure 44 AHP analysis objective hierarchy

Layout A	Layout B	Layout C
0.5663	0.1445	0.2892
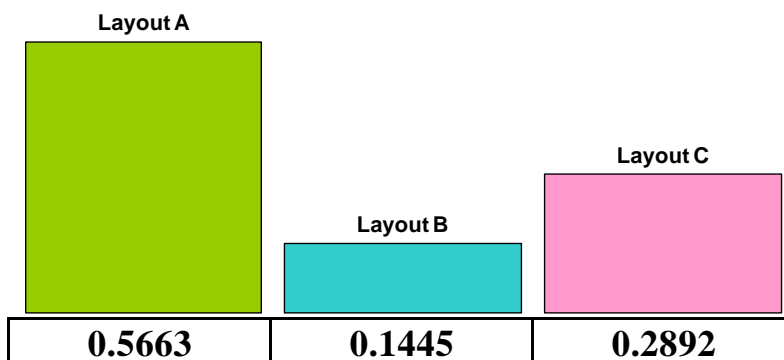
Figure 45 AHP analysis final relative weights

3.3.4 Logistics and supply chain

For the purpose of establishing all logistics and supply chain related activities with little inconsistency, it is of utmost importance to obtain the exact locations of each facility included in the *USIZO LOMUSA* Feeding Scheme business engineering model. The respective coordinates of all the relevant schools, in addition to that of the Shoprite store situated at Theku Plaza are summarised in Table 1Table 23.

Table 23 Coordinates of specific locations

	Location	Longitude	Latitude
1.	Blaauwbosch Primary school		
2.	Mlondolozi Primary school		
3.	Sikhona Primary school		
4.	Siphumelele Primary school		
5.	Shoprite (Theku Plaza)		

3.3.5 Procurement schedule

The procurement of the specific goods and products specified by the predetermined two week cycle Tiny Tots Menu, included within the *USIZO LOMUSA* Feeding Scheme business engineering model, will serve as the basis for the establishment of a procurement schedule.

The previously calculated fixed quantities of ingredients will be compared to the available sizes of specific products. Once the product specific lot sizes are established, the student will compiled the relevant procurement schedule for the first iteration of the business engineering model.

The relevant procurement schedule that will be compiled for the purpose of the first iteration of the business engineering model, will serve as a guideline for the future expansion of the *USIZO LOMUSA* Feeding Scheme.

Although the specific goods and products prescribed by the diet is purchased from the local Shoprite store, the *USIZO LOMUSA* Feeding Scheme business engineering model is not limited to a single supplier. Supplementary economic feasible alternatives may be considered.

4   Phase II – Engineering Development

Due to the fact that a large number of activities and tasks related to the execution of the *USIZO LOMUSA* Feeding Scheme project engineering development phase will be outsourced, the advanced development-, engineering design- and lastly the integration and evaluation sub-sections of the final project report will be brief.

4.1   Advanced Development

The advanced development phase generally involves the forthcoming of numerous uncertainties, which are directly related to the systems concept chosen. The primary objective of the advanced development phase is to minimise the risk related to these irregularities when developing the new system, which is in this case the *USIZO LOMUSA* Feeding Scheme business engineering model. The ideal scenario would entail reducing the risk of the new system, to a level where the functional design of all the previously unproven sub-systems has been validate. The uncertainties can be resolved through analysis, development, prototyping and simulation.

The *USIZO LOMUSA* Feeding Scheme business engineering model requires three practical standardized designs. The respective designs include a layout for the fixed agricultural garden, the arrangement of the stationary kitchen facility and lastly, the mobile kitchen unit.

The designs incorporated in the following sub-sections of the final project report, were specifically developed for the purpose of the first iteration of the *USIZO LOMUSA* Feeding Scheme business engineering model. The individual designs will be validated at the Blaauwbosch Primary school and the three surrounding schools, prior to the extension of the respective designs to supplementary South African schools in need of a feeding scheme. The hypothetical designs will serve as a guideline for the further development of the particular business engineering model, although the relevant designs are subject to change during the first iteration of the business engineering model.

4.1.1 Stationary agricultural garden layout

The *USIZO LOMUSA* Feeding Scheme business engineering model design, related to the stationary agricultural garden at the parent school, were specifically developed using the literature obtained with regard to the *conceptual development* phase of the business engineering model and the referenced book titled *The A-Z of Vegetable Gardening in South Africa*.

Due to the fact that the land available for the stationary agricultural facility of the *USIZO LOMUSA* Feeding Scheme business engineering model is restricted to the unutilized land at Blaauwbosch Primary school, the size of the land had to be incorporated within the mathematical model.

The Northern KwaZulu Natal district has an estimated annual rainfall of one thousand three hundred (1 300) millimetres, which is primarily during the warm summer months. Thus, the occasional watering of the numerous vegetable- and/or crop types to be included within the agricultural garden, have to be considered along with the water availability during dry winter periods.

The two, two thousand two hundred (2 200) liter JoJo tanks donated by the Department of Education, will facilitate rain water relocated from the roof of the most eastern building at Blaauwbosch Primary school. A special feature will be installed to ensure that the rain water is filtered, before it is stored within the JoJo tanks. Furthermore, the two tanks will be interlinked.

The method in which vegetables and/or crops are grown in beds, were specifically chosen for the stationary agricultural garden. This method, would entail the levelling of the beds with the paths or even slightly below the path level during dry seasons. Whilst, it is recommended that the respective beds be raised above the paths during wet months.

The beds may be of any convenient length, although it is of utmost importance to ensure that the beds are at least 1.0 to 1.2 metres wide if they are to accommodate several rows of carrots or beans, and alternatively 2 to 3 rows of tomatoes. The minimum prescribed width of beds will ensure comfortable sowing, transplanting, weeding and harvesting from the respective paths. Paths of three hundred and fifty (350) to five hundred (500) millimetres wide, is sufficient.

The method of square planting, where the individual plants are sowed on a square grid, is recommended within the respective beds. Square planting will ensure a high plant population and significant yields per square metre. This intensive planting methodology will definitely increase the level of nutrients required.

The stationary agricultural garden is the only labour intensive workplace included within the *USIZO LOMUSA* Feeding Scheme business engineering model. The specific facility requires extra body motions when sowing, transplanting, weeding and harvesting the various vegetable- and/or crop types.

Due to the fact that the ergonomics of each individual has to be considered, the student recommended the use of plastic chairs with an approximate height of thirty centimetres (30 cm) for the period in which operators need to sow, transplant, remove weed and harvest the vegetables and/or crops. The proposed chairs are practical and easy to clean. Over and above the used of chairs, the operators will be obligated to wear hats during these periods.

Besides the requested actions in which the respective vegetables- and/or crop types need to be sowed, transplanted, weeded and harvested, a single operator has to water the plants of the stationary agricultural garden. The relevant operator responsible for the watering of the respective plants, will once again be obligated to wear head attire for protection against the sun.

The *USIZO LOMUSA* Feeding Scheme business engineering model promise employment to a single operator, for each two hundred (200) children incorporated within the business engineering model.

Due to the fact that extensive training programmes will be integrated with the *USIZO LOMUSA* Feeding Scheme, both productivity and human protection were addressed.

Furthermore, the rotation of vegetables and/or crops, the cyclical allocation of a recreational space and the use of environmental friendly fertilisers promise to contribute towards the sustainable aspects that were integrated with the *USIZO LOMUSA* Feeding Scheme business engineering model stationary agricultural garden.

Each of the suitable vegetable- and/or crop types included within the Tiny Tots Menu, were incorporated within the mathematical model of the *USIZO LOMUSA* Feeding Scheme. The mathematical model will be used to determine the exact inputs of the stationary agricultural garden, in order to restrict expenses to a minimum. Hence, a significant contribution can be made towards the feasibility of the *USIZO LOMUSA* Feeding Scheme business engineering model.

The annual use of the mathematical model specifically developed for the purpose of the *USIZO LOMUSA* Feeding Scheme, is mandatory. There are no restriction related to the maximum number of times the model may be consulted per year.

A summary of the essential information obtained related to each vegetable- and/or crop type, to be potentially included within the *USIZO LOMUSA* Feeding Scheme business engineering model stationary agricultural garden, were tabulated within Appendix J of the final project report. The information was specifically sourced from the previously mentioned book, *The A-Z of Vegetable Gardening in South Africa*.

The previous presented outline of the current agricultural garden facility located at the Blaauwbosch Primary school, were used to develop a standardized, practical layout specifically for the *USIZO LOMUSA* Feeding Scheme business engineering model stationary agricultural garden. The final design with regard to the stationary agricultural garden, can be examined within Figure 46.

The final design of the stationary agricultural garden were specifically developed using the data reflected within Appendix J. The concluding layout of the stationary agricultural garden was designed to be economic feasible, to incorporate practicality and to represent a standardized layout for the future expansion of the *USIZO LOMUSA* Feeding Scheme business engineering model.

The exact allocation of the various applicable vegetable- and/or crop types, will be provided once the relevant local supplier of the first *USIZO LOMUSA* Feeding Scheme business engineering model iteration is finalized and the associated product specific costs were inserted into the mathematical model.

Lastly, it is important to note that all the activities related to the establishment of the initial stationary agricultural garden infrastructure will be outsourced to a professional in that particular field. Therefore, the execution of a number of high risk tasks will not be incorporated within the *USIZO LOMUSA* Feeding Scheme business engineering model.
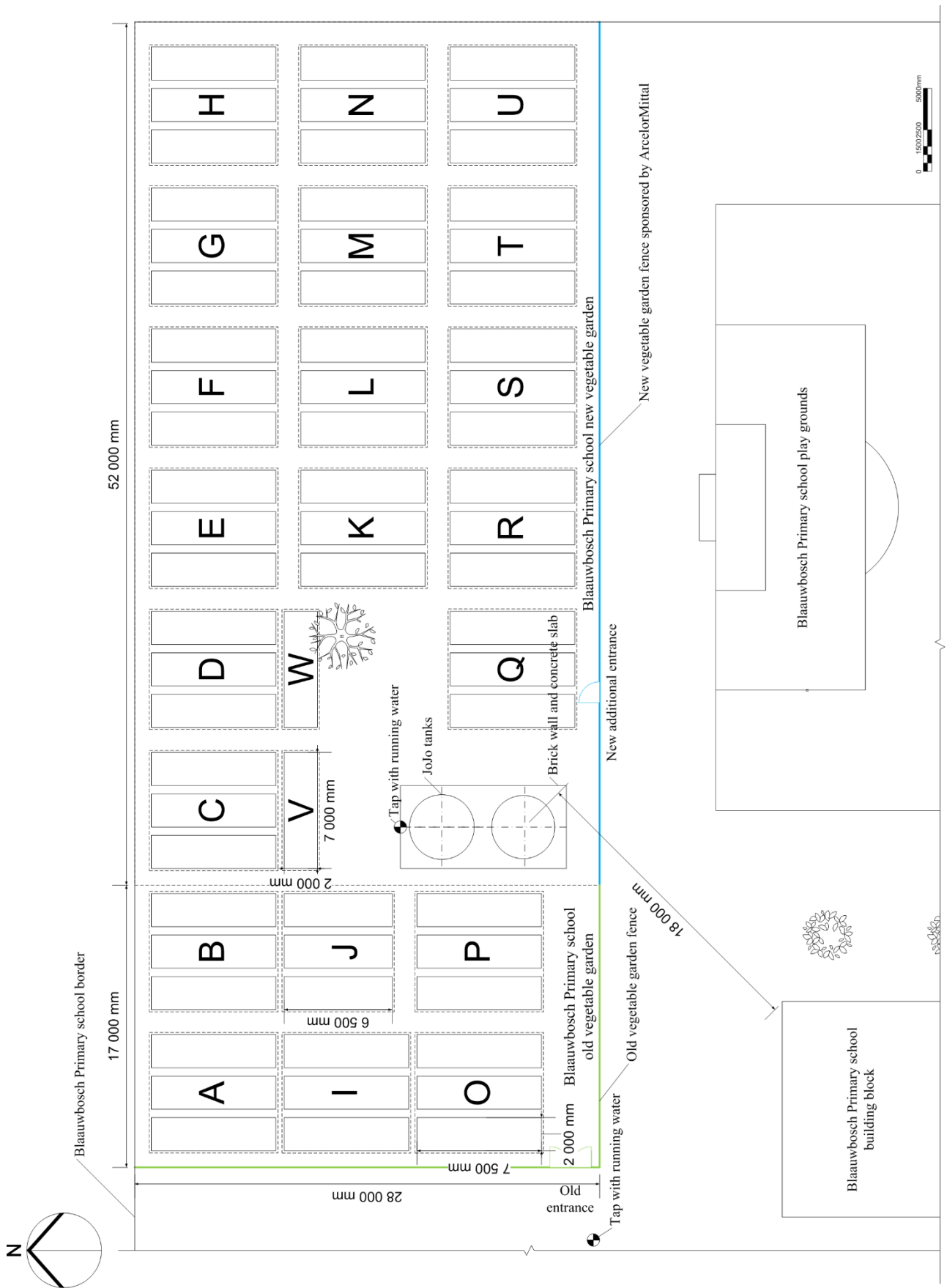
Figure 46 Final design of the *USIZO LOMUSA* Feeding Scheme stationary agricultural garden

4.1.2   Stationary kitchen layout

The stationary kitchen facility, located at the primary school of the *USIZO LOMUSA* Feeding Scheme business engineering model, were partially designed by means of the subsequent steps provided within the *conceptual development* phase of the *literature review* section.

According to the literature obtained with regard to an article that was written on *Facilities in Lean Manufacturing Strategy*, there are four fundamental elements to consider when designing or re-structuring any layout. The four elements can be listed as follow:

1.   Space planning units (SPUs, activity areas)

2.   Affinities (relationships)

3.   Space

4.   Constraints

For the purpose of the *USIZO LOMUSA* Feeding Scheme business engineering model the space planning units, in combination with affinities, were not used to construct an affinity diagram. The affinity diagram which is a representation of an idealized spatial arrangement, were replaced by a primitive layout of the current kitchen facility. Thus, the present layout of the stationary kitchen facility located at Blaauwbosch Primary school served as an outline for the relocation of internal workstations, equipment and tools.

The design constraints of the stationary kitchen facility include the quality assurance related to the preparation of the final food products, the training of operators, the workplace and systems safety, the work design of the relevant operators, and lastly, all applicable legislation and business policies. Each of the mentioned aspects that can be regarded as design constraints, are discussed within the *post development* phase of the final project report.

The addition of the design constraints is the final step in which the spatial arrangement is updated, which results in a Macro layout of the facility. The Macro layout of the stationary kitchen facility located at Blaauwbosch Primary school were compiled, taking all design constraints into consideration.

Lastly, aspects that were considered during the design of the stationary kitchen facility included overproduction, waiting for the next step, unnecessary transportation, over processing, and redundant motion. The central, enlarged workstation (work surface/table) that is closely located to the respective gas stoves, the basin and the dustbin promises to reduce time wasted due to transportation, -unnecessary motion and -waiting for the next step. Hygiene, workplace and systems safety, along with factors such as wall mounted plugs primarily determined the location of specific equipment.

The final design for the *USIZO LOMUSA* Feeding Scheme business engineering model stationary kitchen facility can be viewed within Figure 47, on the subsequent page.
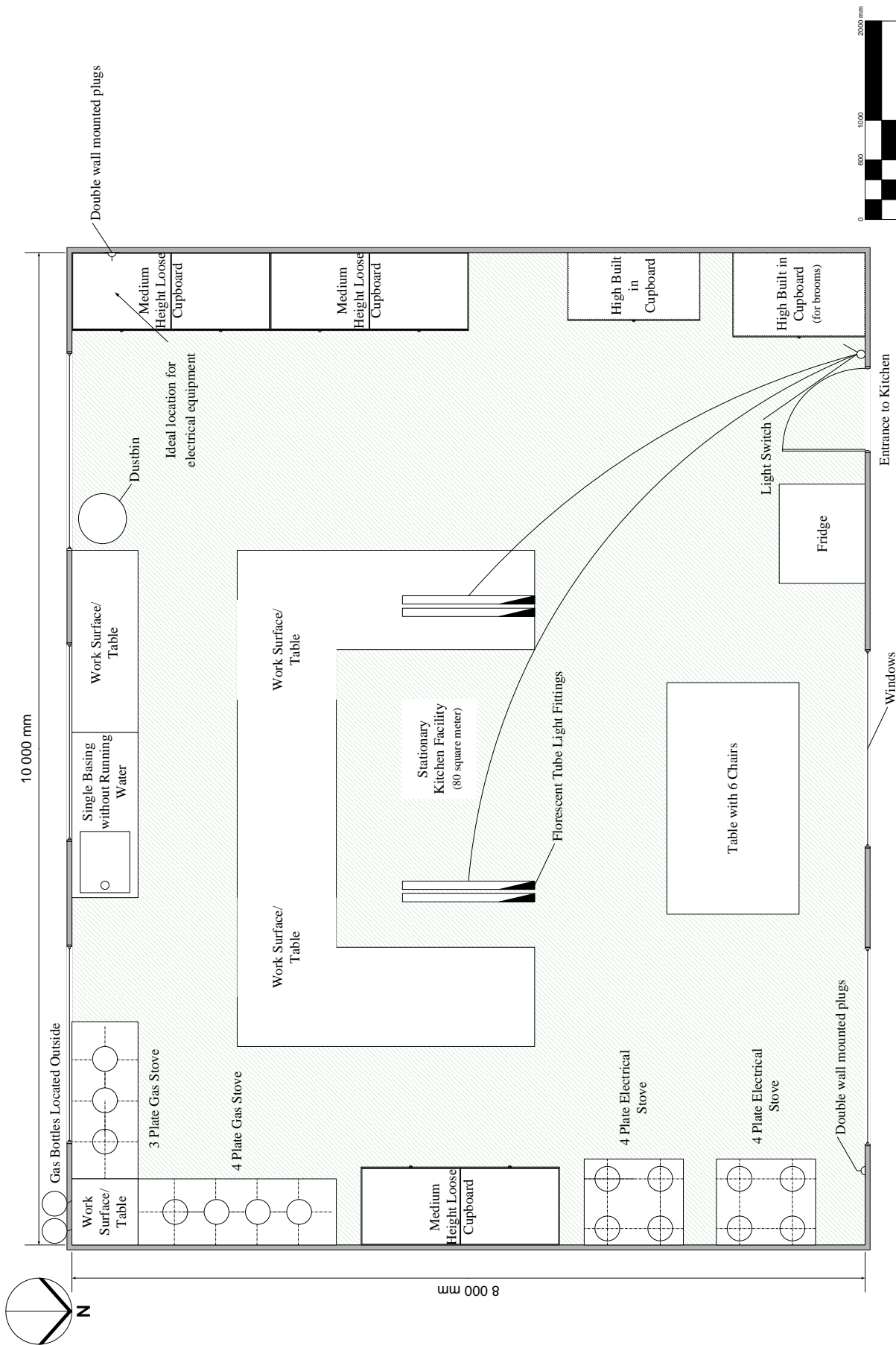
Figure 47 Final design of the *USIZO LOMUSA* Feeding Scheme stationary kitchen facility

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4.1.3 Mobile kitchen unit

The design of the mobile kitchen unit, initially requested by the three individuals, were specifically developed using the results of the AHP analysis executed within the *concept definition* sub-section of the *concept development* phase. The layout of preference were indicated as Layout A. Thus, the level of advanced features, practicality, associated price and space related to Layout A that were previously stated, were incorporated in the final design of the mobile kitchen unit.

The design related to Layout A entails the possible incorporation of mobile water purification equipment, along with airtime procurement facilities on board the mobile kitchen unit, due to the availability of unutilised space. The specific advanced features will only be included, should the need arise once the *USIZO LOMUSA* Feeding Scheme business engineering model is implemented and fully operational. Furthermore, Layout A can be regarded as practical, although the practicality factor has cost implications.

Several aspects were considered during the design of the *USIZO LOMUSA* Feeding Scheme business engineering model mobile kitchen unit. The numerous facets can be listed as follow:

1. The availability of several dish up points, to increase the rate at which food is provided to the pupils of the relevant secondary schools.

2. Facilities to enable the responsible operators, to keep the final food products warm.

3. Temporarily storage facilities.

4. Refrigerator conveniences, with a capacity of one hundred and twenty (120) litre, for the successful transportation of the suggested afternoon snacks.

5. Sustainable power sources for the florescent tube light fittings, the two plate gas stove and the refrigerator.

6. Water supply, in order to enable basic rinsing and cleaning if needed. Water supply would also be required by the water purification equipment, if installed at a later point in time.

7. Hygiene.

8. Workplace and systems safety.

9. Ergonomics.

The customized trailer required by the *USIZO LOMUSA* Feeding Scheme business engineering model, will have two window openings, which will serve as dish up points. An adjustable footstep has to be mounted at each side of the mobile kitchen unit where the window openings are located, to enable the relevant children to easily receive the final food products. A wheel chair ramp have to be available on request, to accommodate disabled persons.

The trailer has to be equipped with a two plate gas stove to ensure that the necessary final food products are kept warm. Temporarily storage facilities will be available beneath the respective working surfaces. A refrigerator is recommended for the successful transportation of the afternoon snacks.

Power sources that were investigated within the *literature review* section of the final project report, included solar panels and LP gas systems. A single one hundred and twenty (120) Watt solar panel will enable the production of light through the florescent tube light fittings, whilst a LP gas system will be used as power source for both the two plate gas stove and the refrigerator.

The water supply have to be received from an external water source, such as a hosepipe at the designated school, in order to ensure that the total weight of the trailer is retained to a minimum.

Hygienic flooring and sealed wall coatings have to be included within the trailer.

The respective gas bottles have to be accessed from the outside of the mobile kitchen unit for safety reasons. Furthermore, it is of utmost importance to ensure that the refrigerator has a travel lock and that all equipment and tools to be used within the mobile kitchen unit are secured when in motion. A first aid kit on board the trailer is compulsory.

Aspects related to ergonomics, include sufficient aisle space and work surface heights specifically designed to be elbow height. This particular topic is also addressed within the *work design* sub-section of the *post development* phase.

For the purpose of the first iteration of the *USIZO LOMUSA* Feeding Scheme business engineering model, the local trailer manufacturer Hambisa were considered as a potential manufacturer by ArcelorMittal Newcastle works. Figure 48 is a photo of one of the made-to-order trailers, manufactured by Hambisa.

Figure 48 Photo of a customised trailer constructed by the Hambisa manufacturer

The final design of the mobile kitchen unit illustrated in Figure 49, will serve as a guideline for the further expansion of the *USIZO LOMUSA* Feeding Scheme business engineering model. Should the demand of the respective group of consumers change, the technique in which AHP analysis is applied can be repeated to determine the optimal mobile kitchen layout.
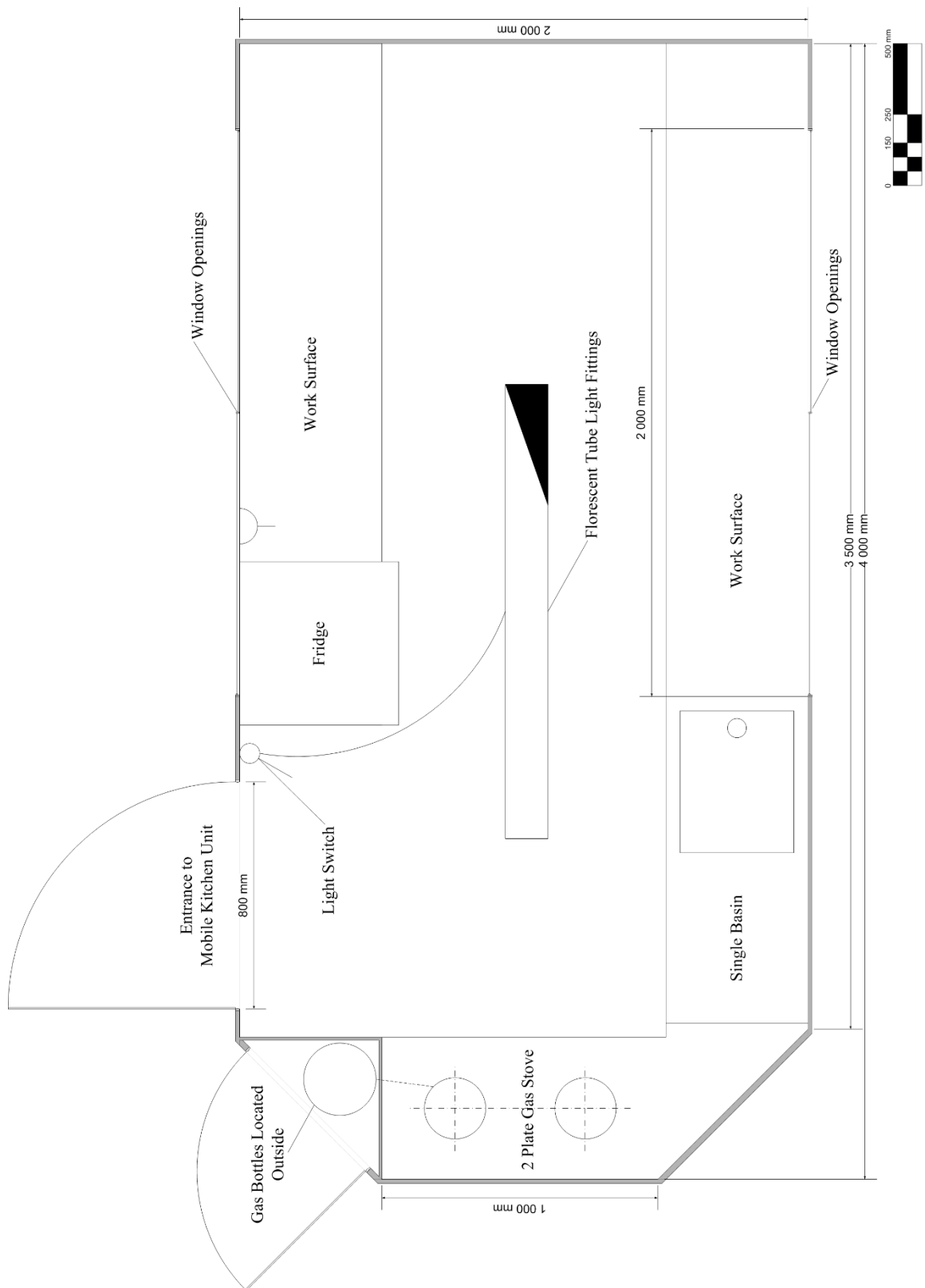
Figure 49 **Final design of the** *USIZO LOMUSA* **Feeding Scheme mobile kitchen unit**

4.2 Engineering Design

The engineering design phase specifically requires the design of all the system related component parts, to fit together in the complete system that will adhere to all the relevant system operational requirements stated previously.

For the purpose of the *USIZO LOMUSA* Feeding Scheme business engineering model, the system related component parts can be regarded as the logistics and supply chain related to the entire *USIZO LOMUSA* Feeding Scheme business engineering model, the stationary kitchen facility, along with the mobile kitchen facility. Furthermore, a delivery schedule applicable to the relevant identified supplier will also be incorporated in this section, once a procurement schedule is established.

4.2.1 Logistics and supply chain

The logistics and supply chain with regard to the first iteration of the *USIZO LOMUSA* Feeding Scheme business engineering model, were previously discussed in the *concept exploration* sub-section of the final project report.

For the purpose of ease the logistics and supply chain segment were divided into three principal categories, which entails the entire *USIZO LOMUSA* Feeding Scheme, the stationary kitchen facility and the mobile kitchen unit. The final project report will only address the last two categories, since the supplier is not finalised at this point in time. Flow diagrams will be used to graphically illustrate the flow of goods, products and raw materials from the procurement stage, up until the delivery of the final food product to the consumer.

1. Stationary kitchen facility

Logistics and supply chain is not only applicable to the broader picture. The movement of materials occurs within the production of the final food products, which takes place in the stationary kitchen facility situated at the parent school. The following diagram Figure 50 clearly indicates the flow of goods, products and raw materials within the specific facility.
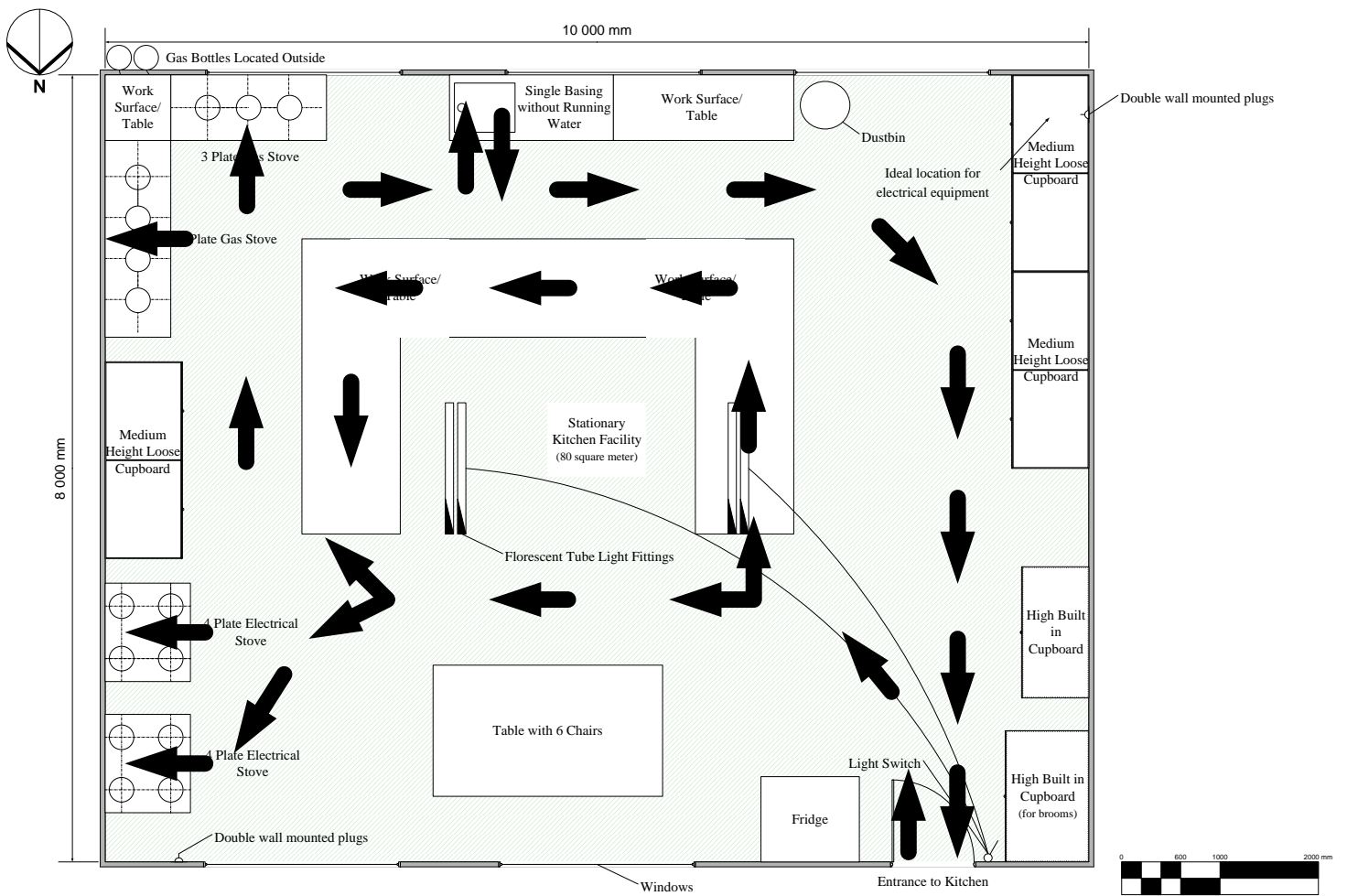
Figure 50 Flow diagram applicable to the stationary kitchen facility at Blaauwbosch Primary school

2. Mobile kitchen unit

The logistics and supply chain activities related to the mobile kitchen unit, entails a micro perspective of the work flow within the trailer. The workflow illustrated in Figure 51 is specifically applicable to the mobile kitchen unit, when the final food products that were previously prepared are delivered to nearby situated schools, included in the model specific *USIZO LOMUSA* Feeding Scheme.
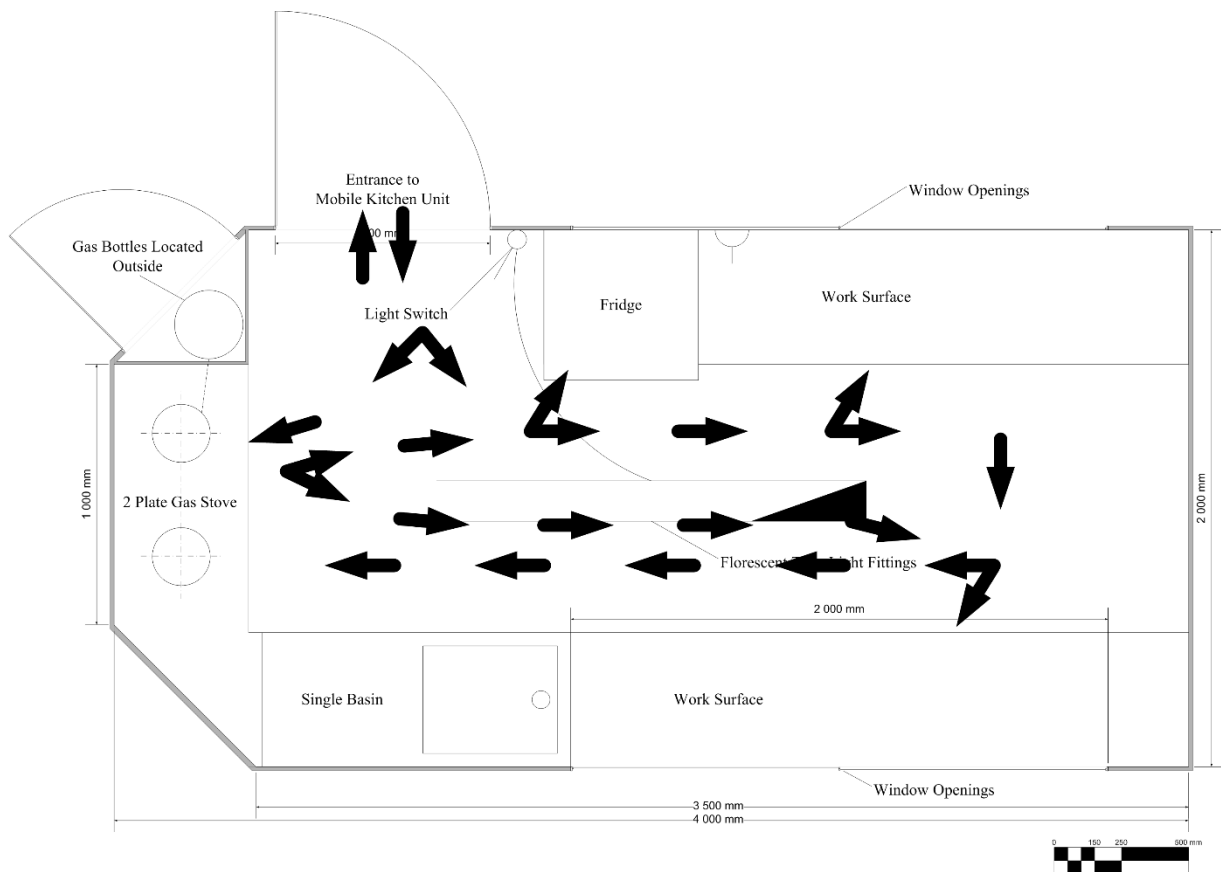
Figure 51 Flow diagram applicable to the mobile kitchen unit related to the first iteration of the business engineering model

4.3 Integration and Evaluation

The integration, testing and evaluation of the complete system is of utmost importance to ensure the effective operation of the entire system. It is the phase in which the complete system is put to the test, to demonstrate its competence and capability to meet all of the prescribed operational requirements.

4.3.1 Feasibility assessment

A feasibility test will be conducted, with the sole purpose of determining whether the proposed implementation of the *USIZO LOMUS* Feeding Scheme business engineering model will be viable.

The ImpactCs framework constraints illustrated in Table 10, which is included within the concept development *data collection* sub-section, will not be used for the execution of the feasibility assessment. The ImpactCs framework primarily considers constraints, consisting out of time-, financial-, legal-, personal-, social-, cultural-, and/or political restrictions.

The execution of similar *Business Engineering* (BPZ 421) module tools listed within the *literature review* section of the final project report, is preferred over and above the researched ImpactCs framework.

The specific *Business Engineering* module tools used to derive a business strategy, include PESTLE analysis, Porter's Five Forces, the seven S's, SWOT analysis and lastly, scenario planning. The primary motive for deciding upon using the mentioned *Business Engineering* module tools, is due to the fact that it is comprehensive and do not only consider restrictions. Furthermore, the *Business Engineering* module tools consider all practical constraints and reflect the potential optimal strategy that need to be followed for the successful implementation of the relevant business engineering model.

Thus, the relevant *Business Engineering* module tools will be used extensively, for the purpose of validating the first iteration of the *Mobile Feeding Scheme* business engineering model at the Blaauwbosch Primary school.

5 Phase III – Post Development

The *post development* section of the *USIZO LOMUSA* Feeding Scheme business engineering model project entails all aspects related to the installation, operations, production and support of relevant complex system. Furthermore, the section includes affordability considerations, to ensure that the system related to the execution of the *USIZO LOMUSA* Feeding Scheme business engineering model is fully effective in the specific intended environment. The third phase will be performed using two sub-sections titled production and the second, operations and support.

5.1 Production

According to the textbook Systems Engineering Principles and Practice, the *production* sub-section can be regarded as a concluding development process, leading to the manufacturing and distribution of the multiple units that were engineered and tested against specific criteria. The primary objective of this segment is to embody the engineering designs and specifications generated during the previously executed engineering development phase.

5.1.1 Quality assurance

For the purpose of the *USIZO LOMUSA* Feeding Scheme business engineering model, quality assurance principles will be applied to the goods and products purchased from the closest local supplier, the fresh food products grew in the stationary agricultural garden and lastly, the final food products produced within the stationary kitchen facility.

In order to ensure quality assurance throughout the mentioned divisions related to the specific business engineering model, research were conducted with regard to food safety programs. The student came upon a scheme titled SGS, who developed a food safety program. The relevant product offers a safe quality food (SQF) standard certification for organizations who handles, prepares, processes and produces food related products to the highest possible standards.

Therefore, it is suggested that the process in which the quality of the relevant outputs, related to the *USIZO LOMUSA* Feeding Scheme, is evaluated and certified by an external party such as the SGS.

Over and above the SQF standard certification for products of the highest possible standards, it is of utmost importance to consider the food safety and quality regulations applicable in South Africa. The relevant legislation related to each of the three divisions included in the *USIZO LOMUSA* Feeding Scheme business engineering model, will be briefly discussed within the subsequent paragraphs.

Due to the fact that the nearby local supplier of goods and products for the first iteration of the *USIZO LOMUSA* Feeding Scheme was identified as a Shoprite store, it can be assumed that all the products to be obtained from the relevant store are safe for human consumption with regard to the Foodstuffs, Cosmetics and Disinfectant Act of 1972, along with the Standards Act of 1993.

The fresh food products to be produced within the stationary stationary agricultural garden of the *USIZO LOMUSA* Feeding Scheme business engineering model, have to comply with the Foodstuffs, Cosmetics and Disinfectant Act of 1972, in addition to the Agricultural Product Standards Act of 1990.

Furthermore, the Foodstuffs, Cosmetics and Disinfectant Act of 1972 is applicable to the manufacturing- and labelling process of all final food products produced within the stationary kitchen facility, in order to ensure that the relevant food is safe for human consumption.

Matters associated with the hygiene of food related products, which is applicable to the *USIZO LOMUSA* Feeding Scheme business engineering model stationary kitchen- and mobile kitchen unit facility, will be censored by the National Health Act of 2003.

5.1.2 Sustainable farming practices

Research related to sustainable farming practices within South Africa, were conducted in the *literature review* section of the final project report. A decision was made with regard to the *USIZO LOMUSA* Feeding Scheme business engineering model, to demonstrate a good stewardship of natural resources. The decision would imply that all agricultural activities executed with regard to the *USIZO LOMUSA* Feeding Scheme business engineering model, have to be sustainable with minimal impact on the direct environment.

During the time in which the student conducted research related to sustainable farming practices, the student noticed that sustainability does not only entail the long term protection of productive land used for agricultural purposes. The viable production of profitable yields together with the welfare of both the farmers and their employees, contribute towards sustainability.

A number of sustainable aspects were incorporated in the *USIZO LOMUSA* Feeding Scheme business engineering model, such as the rotation of crops within the stationary agricultural garden, the cyclical allocation of a recreational space within the stationary agricultural garden, rain water catchment facilities and use of environmental friendly fertilisers. Due to the fact that the agriculture sector is generally regarded as a poverty alleviator, the relevant business engineering model will also contribute to the establishment of a number of job opportunities.

Lastly, a partnership with the WWF-SA is recommended. The WWF-SA motivates innovative ideas with regard to preservation efforts, which includes the effective management of catchments, rivers, wetlands and soil. Thus, the relationship with the WWF-SA will assist the *USIZO LOMUSA* Feeding Scheme in ensuring a healthy, properly functioning natural system.

5.1.3 Work design

The human capabilities and motion economy are of utmost importance when doing motion study on labour intensive work. Should the work design related to the stationary agricultural garden, the stationary kitchen facility along with the mobile kitchen unit of the *USIZO LOMUSA* Feeding Scheme business engineering model be considered, it can be concluded that all relevant designs were developed for the average. In other words, the principle of design for the average were applied.

For the purpose of the *USIZO LOMUSA* Feeding Scheme business engineering model, the manual work required by the stationary agricultural garden is the only labour intensive workplace that requires extra body motions when sowing, transplanting, weeding and harvesting the various vegetable- and/or crop types. For health purposes and ease, the use of plastic chairs with an approximate height of thirty centimetres (30 cm) was recommended for the period in which operators need to sow, transplant, remove weed and harvest the vegetables and/or crops. The reason for the recommendation of plastic chairs, is due to the fact that the relevant chairs are practical and easy to clean. Furthermore, the operators will be obligated to wear hats during these periods.

Besides the requested actions in which the respective vegetables- and/or crop types need to be sowed, transplanted, weeded and harvested, a single operator has to water the plants of the stationary agricultural garden. Watering the plants entails standing in an upward position for short time periods, which can be regarded as ergonomic viable. The relevant operator responsible for the watering of the respective plants, will once again be obligated to wear head attire for protection against the sun.

Concerning the stationary kitchen facility, together with the mobile kitchen unit, the majority of the work surface heights were designed to be elbow height. The work surface heights were adjusted according to the respective tasks that need to be performed at the specific stations. Compatible chairs were allocated to the operators employed in the stationary kitchen facility. Furthermore, the necessary tools and materials were designed to be within the normal working area to minimise motions, in addition to the fixed locations that were allocated to the specific tools and materials in order to ensure the execution an optimal sequence. Sufficient work- and aisle space were incorporated in both the stationary kitchen facility and the mobile kitchen unit.

5.1.4 Shift structure

Due to the fact that the *USIZO LOMUSA* Feeding Scheme business engineering model is applicable to all South African schools in need of a feeding scheme, the shift structures related to the business engineering model will be arranged accordingly. This is the primary reason why the relevant business engineering model is incapable of providing scholars with a balanced nutritional diet on weekends, public holidays and school holidays, at this point in time.

Within the *concept exploration* sub-section in which the *USIZO LOMUSA* Feeding Scheme business engineering model diet was made available, specific times were allocated to each of the following segments included in the Tiny Tots Menu: breakfast, own snack, lunch and snack. The times allocated to each meal on the Tiny Tots Menu are estimates, since the primary- and secondary beneficiary schools will not receive food at the same time.

The relevant operators responsible for the successful execution of the *USIZO LOMUSA* Feeding Scheme, have to start preparing the first meal of each day at seven o'clock in the morning promptly. Preparation related to the lunch that need to be served at one o'clock in the afternoon, will also start at seven o'clock, although it will only be continued after eleven o'clock in the morning. The preparation related to lunch, that need to be executed during the early morning hours, entails the sourcing of all the relevant products.

Finally, the snacks of the primary school will be handed out at three o'clock in the afternoon from the stationary kitchen facility, whilst the snacks of the secondary schools will be handed out at the relevant schools at that particular time, although it will already be delivered to the specific schools during the time allocated for the delivery of lunch. The operators will complete a full day of work at four o'clock in the afternoon. This imply, that a single operator will work eight hours per day, with a one hour break between ten- and eleven o'clock. The operators will only be functioning for the five subsequent working days in a week.

Table 24 on the subsequent page is a tabulated representation of the previously described shift structure, which is applicable to all the operators responsible for the procurement of goods and products, the sourcing of raw products from the stationary agricultural garden, the preparation of the final food products for the relevant primary- and secondary schools and finally the delivery of the final food products to the secondary schools.

Table 24 *USIZO LOMUSA* **Feeding Scheme business engineering model shift structure**

Time slot	Task Description
07:00-08:00	Preparation of breakfast/lunch, provide breakfast to primary school and deliver breakfast to secondary schools.
08:00-09:00	
09:00-10:00	
10:00-11:00	Break
11:00-12:00	Preparation of lunch, provide lunch to primary school and deliver lunch and snacks to secondary schools.
12:00-13:00	
13:00-14:00	
14:00-15:00	
15:00-16:00	Provide snacks at primary school, procurement, stock take and watering of stationary agricultural garden

5.1.5 Training

For the purpose of the *USIZO LOMUSA* Feeding Scheme business engineering model, the student investigated possible training courses available for the respective operators responsible for the preparation of the requested final food products. The primary objective for the recommendation of training related to food preparation and farming practices, is to ensure that the operators are educated, competent and capable of conducting the relevant activities in a safe manner.

The further education of the applicable individuals acting as operators within the *USIZO LOMUSA* Feeding Scheme business engineering model will not only benefit the children of the several schools involved, but similarly the larger community.

Research related to food preparation certificate programs that promise to equip each participant with the necessary skills on how to properly handle-, prepare- and store a variety of food items, were conducted. The information that were obtained, indicated that adequate knowledge related to the cleaning and sanitizing regulations of kitchens and -tools will be gained through the completion of the relevant programs.

Research, with regard to farming practices revealed that there are several organisations that are capable of identifying agricultural training needs within existing practices, organisations who can develop and utilise existing skills and lastly, organisations who is capable of assisting with funding for training purposes.

Lantra were recognised as a suitable organisation satisfying all of the above mentioned requirements. The organisation has a Skills Sector Council especially for the agricultural industry.

Another organisation is Train to Gain, which is an organisation with the primary objective of improving the skills of employees in a wide variety of businesses types. They could provide assistance in finding a local training provider and possible sources for funding.

With regard to the first iteration of the *USIZO LOMUSA* Feeding Scheme business engineering model, Amajuba College along with Boston College were identified as the two institutions within the Newcastle district that is capable of executing the relevant food preparation- and farming practices courses.

5.1.6 Procurement schedule

The procurement schedule specifically developed for the first iteration of the *USIZO LOMUSA* Feeding Scheme business engineering model, can be viewed within the *concept exploration* sub-section of the final project report. Due to the fact that the relevant procurement schedule is specifically developed for the benefit of three thousand and fourty six (3046) children, the procurement schedule may differ for future applications of the *USIZO LOMUSA* Feeding Scheme business engineering model. The procurement schedule included within the final project report, will serve as guideline for future implementations of this specific business engineering model.

5.2   Operations and Support

The following sub-section in which operations and support are addressed is specifically intended for the time period in which the product, that was previously developed thorough the conceptual- and the engineering development phases, perform the operational functions for which it was designed. Although the tasks related to the Industrial Engineer have been completed in theory, the relevant system is incomplete in practice.

5.2.1   Legislation

The sub-section titled *legislation*, entails legal necessities required for the successful operation of the *USIZO LOMUSA* Feeding Scheme business engineering model. The legal requirements include business policies and employee contracts.

1.   Business policies

The incorporation of business policies, with regard to the *USIZO LOMUSA* Feeding Scheme business engineering model, are of utmost importance to unmistakably define the business model views and objectives. Procedures are generally implemented to support each business policy. The relevant procedures clearly explain the application of each policy to the customers, employees and products. Typical areas where business policies are present, consist of accounting, customer service, ethics and human resources.

The business policies related to the *USIZO LOMUSA* Feeding Scheme business engineering model are stated within the subsequent paragraphs. The incorporation of business policies include the list of previous defined typical areas, along with the specific business structure.

1.1   Business structure

For the purpose of ensuring effective operations throughout the relevant business engineering model, a well-defined business structure is essential. The *USIZO LOMUSA* Feeding Scheme business engineering model business structure, applicable to all the relevant operators employed within the feeding scheme, can be observed within Figure 52.
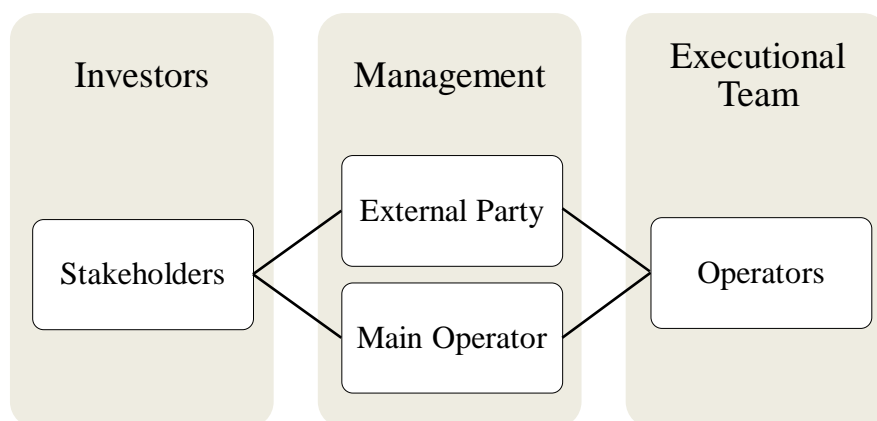
Figure 52 *USIZO LOMUSA* **Feeding Scheme business engineering model business structure**

1.2   Accounting

The *USIZO LOMUSA* Feeding Scheme is a community based organisation, which implies that no profit may not be generated. Should a profit be made, the money will be used for annual maintenance to assets and/or fixed facilities. Else, the money have to be donated towards similar community based projects.

The capital to be incurred through stakeholders driving the *USIZO LOMUSA* Feeding Scheme business engineering model, have to be paid into a valid South African bank account specifically created for the purpose of the feeding scheme. A single operator will be issued with a card for the specific *USIZO LOMUSA* Feeding Scheme bank account. Thus, the relevant operator will be responsible for all payments related to the procurement of the necessary goods and products. Furthermore, the appointed main operator will be accountable for the payment of colleague salaries at the end of each month.

In addition to the list of previously mentioned responsibilities, the main operator will also be responsible for the bookkeeping of all incoming- and outgoing transactions, which will be audited by an external party once a month.

1.3   Customer service

The operators employed by the *USIZO LOMUSA* Feeding Scheme, have to continuously display a positive attitude towards the children of the primary- and secondary beneficiary schools of the business engineering model. This would imply that the operators have to be friendly and courteous whilst busy executing any business related task.

Lastly, the relevant individuals have to oblige to the stakeholders of the specific *USIZO LOMUSA* Feeding Scheme business engineering model iteration and be appropriately dressed at all times.

1.4   Ethics

The *USIZO LOMUSA* Feeding Scheme business engineering model expects appointed operators to be honest, fair, to have integrity, be devoted to the feeding scheme and lastly, to respect each other and themselves.

In the case where theft or fraud is suspected, it is the responsibility of the specific operator(s) to either inform the main operator or the external party responsible for the auditing of the books on a monthly basis. This would imply that the business structure that was previously defined have to be followed for the reporting of a misconduct.

1.5 Human resources

The hiring of new operators, with regard to the *USIZO LOMUSA* Feeding Scheme business engineering model, will be subject to a three month probation period during which the stakeholders will evaluate the duties of the relevant operator(s) before the consideration of more permanent employment.

The condition on which operators are appointed includes the restraint that each relevant individual has to have at least one biological child in any one of the beneficiary schools. Therefore, an employment contract will be terminated once the operator do not have a biological child left in any of the schools included in the relevant business engineering model iteration.

Other infractions, which can lead to immediate suspension, temporary termination or a hearing, depending on the degree of severity, include the violation of any of the business model policies stated within this section, absenteeism form work without a valid letter from a doctor and lastly, irregularities and deliberate wrongdoings adequate for a written warning. Should a single operator be issued with three written warnings, the relevant operator has to appear in a hearing where after the operator might be dismissed.

The minimum period for which an operator can be employed is one year, should the relevant operator be approved by the relevant stakeholders after the provisional time interval.

Due to the fact that the relevant operators obtain training on the expense of the *USIZO LOMUSA* Feeding Scheme, the employees will not be considered for a salary increase. However, advancement to the main operator position is possible. The promotion to the main operator position involves at least one year experience as an operator within the *USIZO LOMUSA* Feeding Scheme. The salary of the main operator will be higher than that of the other operators, due to the increased responsibility and risk involved.

2. Employment contract

During the period in which the student completed the *Labour Relations* (ABV 320) module as part of the Industrial Engineering curriculum, the student became acquainted with legal requirements that is mandatory for a labour contract.

For the purpose of the *USIZO LOMUSA* Feeding Scheme business engineering model, an employment contract was compiled based on a template provided by the CCMA. The relevant employment contract is included within Appendix K of the final project report.

5.2.2 Workplace and systems safety

The workplace and systems safety specifically incorporated in the *USIZO LOMUSA* Feeding Scheme business engineering model, were referred to in each of the design phases related to the stationary agricultural garden, the stationary kitchen facility and lastly, the mobile kitchen unit.

Due to the fact that extensive training programmes are integrated with the *USIZO LOMUSA* Feeding Scheme, both productivity and human protection were addressed.

Finally, all the activities related to the development of the initial stationary agricultural garden infrastructure will be outsourced to a professional in that particular field. Therefore, the execution of a number of high risk tasks will not be incorporated within the *USIZO LOMUSA* Feeding Scheme business engineering model.

5.2.3 Performance rating and allowance

For the purpose of the *USIZO LOMUSA* Feeding Scheme business engineering model, performance ratings will be based on the completion of specific predetermined tasks that were specified within the work allocation schedule included within the *engineering development* section of the final project report. The work allocation schedule was specifically developed for the first iteration of the business engineering model, which entails the employment of fifteen (15) operators. The relevant schedule will serve as a guideline for further enlargement of the *USIZO LOMUSA* Feeding Scheme business engineering model.

The allowance currently obtained by the individuals responsible for the execution of the National School Nutrition Programme at the Blaauwbosch Primary school, was considered for the purpose of establishing an appropriate monthly salary for the operators employed in the *USIZO LOMUSA* Feeding Scheme.

The operators to be engaged in the *USIZO LOMUSA* Feeding Scheme business engineering model, will work eight hours per day for the five consecutive work days in a week. This would imply that each operator will work a total of fourty (40) hours per week. Therefore, the student eventually decided upon basing the relevant amounts to be incurred by the respective operators, on the South African governmental prescribed minimum wage for fourty (40) hours of work per week. The main operator will receive a ten (10) percent increase over and above the prescribed minimum wage.

The relevant amounts are included within the employment contract provided within Appendix K of the final project report.

5.2.4 Prearranged time systems

The prearranged time system that will be used for the purpose of monitoring operator attendance at the primary school of each *USIZO LOMUSA* Feeding Scheme business engineering model, entails a manual system in which the main operator transcribes the exact time at which each operator arrives at the stationary kitchen facility in the morning. The manual system will once again require inputs of the particular time at which each operator complete a day of work, from the main operator.

Each individual operator will be requested to complete a work description book provided by the Department of Labour, in which they have to indicate the relevant tasks that were performed on a particular day in addition to the arrival time and the time the individual left the stationary kitchen facility. Department of Labour officials are authorised to request an audit of the relevant credentials at any given point in time.

Furthermore, the magnetic employee card illustrated in Figure 53 will be allocated to each operator. The magnetic employee cards will enable the process in which the relevant number of operators are manual located on a panel, based on their statuses within the *USIZO LOMUSA* Feeding Scheme system. The panel containing the live location of operators, will be displayed within the stationary kitchen facility at the parent school. An example of the board to be located within the stationary kitchen, can be viewed within Figure 54 on the following page.
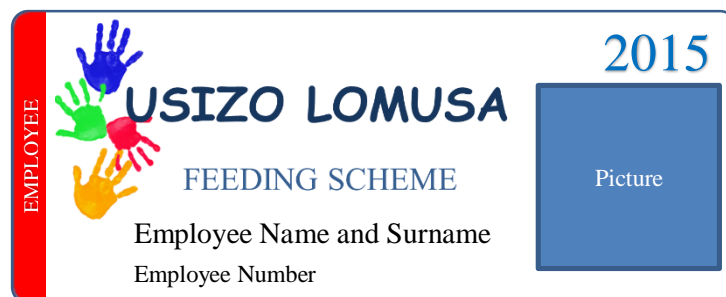
Figure 53 Preview of magnetic *USIZO LOMUSA* employee cards to be allocated

Stationary agricultural garden	Kitchen Facility	Mobile kitchen unit
1.	1.	1.
2.	2.	2.
3.	3.	3.
4.	4.	4.
5.	5.	5.
6.	6.	6.
7.	7.	7.
8.	8.	8.
9.	9.	9.
10.	10.	10.
11.	11.	11.
12.	12.	12.
13.	13.	13.
14.	14.	14.
15.	15.	15.

Figure 54 Sample of the magnetic panel to be located in the stationary kitchen facility of the parent school

5.2.5   Balanced scorecard

This previously researched strategic planning and management tool, will be used to transform the complex vision and mission of the *USIZO LOMUSA* Feeding Scheme business engineering model. The comprehensible practical system representing a common goal of the individuals, the business engineering model and stakeholder initiatives, will include performance measures and/or priorities. The relevant measures and/or priorities will be effectively communicated to all levels of the business structure related to the *USIZO LOMUSA* Feeding Scheme, in order to ensure that the single goal of providing final food products to children is achieved.

The four primary views of an organisation (customer, financial, internal processes and lastly, learning and growth) were specifically addressed within the one page strategy balanced scorecard compiled for the purpose of the *USIZO LOMUSA* Feeding Scheme business engineering model. The relevant balanced scorecard that will be completed by the entire management- and executional team on a monthly basis, can be viewed within Appendix L of the final project report.

5.2.6 Invoicing

The operations and support functions related to the *USIZO LOMUSA* Feeding Scheme business engineering model, require the establishment of necessary invoicing documentation. When stakeholders make donations, sponsorships, monthly and/or annual payments towards the *USIZO LOMUSA* Feeding Scheme, an invoice have to be issued as proof of the agreement. A *Pro Forma Invoice* will be used for the purpose of the *USIZO LOMUSA* Feeding Scheme business engineering model.

Invoice specific details include the credentials of both the interacting parties, the transaction date, respective VAT numbers, an item list, a transaction description, relevant quantities, the unit amount, the VAT amount if applicable, the total amount, payment terms and lastly, the banking particulars of the appropriate *USIZO LOMUSA* Feeding Scheme account.

The invoice created with regard to the *USIZO LOMUSA* Feeding Scheme business engineering model can be observed within Appendix M of the final project report.

5.2.7 Disaster management

Due to the fact that we live in a world of variance and deviances, it is of utmost importance to have a system that is specifically designed to be resilient. A robust system will ensure survival, when unexpected changes are enforced on factors that could have a direct impact on the relevant system. Should a system fail to withstand the unforeseen external factors, disaster management have to be applied.

For the purpose of the *USIZO LOMUSA* Feeding Scheme business engineering model, the system related to the stationary agricultural garden at the relevant parent school were specifically design to incorporate disaster management.

The fact that specific vegetable- and/or crop types included within the stationary agricultural garden can be directly affected by unforeseen weather circumstances and natural disasters, was a definite indication of the need for a disaster management action plan. The disaster management action plan that were put into place, include the incorporation of a twenty percent (20 %) degree of error as part of the monthly *USIZO LOMUSA* Feeding Scheme business engineering model budget, in addition to the inclusion of a previously specified number of maize in the vegetable garden.

Detail related to each of the aspects included within the disaster management action plan, can be observed within the stationary agricultural garden layout segment of the *advanced development* sub-section, along with the *financial considerations* sub-section of the following section.

6   Conclusive Considerations

6.1.1   Patent

Research with regard to the requirements related to patents in South Africa were conducted within the *post development* sub-section, of the *literature review* section that is included in the final project report. The research consisted out of patent characteristics, the exclusion of certain patent characteristics, the current South African patenting process, the relevant patent costs involved, the advantages of patent protection and lastly, the information required for the patent process.

A patent within the South African context, can be defined as an invention that is new, inventive and useful. If an invention formally adhere to all three of the mentioned characteristics, a patent in terms of the South African law may be granted for the specific invention although the relevant patent might be subject to certain exclusions that were previously discussed.

The student responsible for the execution of the *USIZO LOMUSA* Feeding Scheme business engineering model intends to use the research that were previously conducted, for the purpose of patenting the business engineering model once the first iteration of validation was successfully executed at Blaauwbosch Primary school and neighbouring schools. Even though the University of Pretoria legally maintain ownership of the relevant project, patenting the project would entail the involvement of the University of Pretoria in the future development of the *USIZO LOMUSA* Feeding Scheme business engineering model.

6.1.2 Stakeholders

The complete *USIZO LOMUSA* Feeding Scheme business engineering model, can only be successfully implemented with the assistance of external resources. Thus, the relevant student investigated several alternatives with regard to potential stakeholders for the *USIZO LOMUSA* Feeding Scheme. The respective stakeholders that were identified, will be briefly discussed within the sub-sections that follow. Furthermore, contributions with regard to the *USIZO LOMUSA* Feeding Scheme business engineering model, do not necessarily imply financial aid, but can also include physical assistance, goods or products.

1. ArcelorMittal Newcastle works

The three independent volunteers at the Blaauwbosch Primary school initially contacted Mr Mntambo, who is the environmental manager at ArcelorMittal Newcastle works, during which they informed Mr Mntambo that they are in need of a mobile kitchen. Thereafter, the concept related to the development of the *USIZO LOMUSA* Feeding Scheme business engineering model evolved.

Therefore, the relevant project sponsor ArcelorMittal Newcastle works will have the first option, for financing the first iteration of the *USIZO LOMUSA* Feeding Scheme business engineering model. The first iteration entails the validation of the business engineering model at the Blaauwbosch Primary school and the three neighbouring schools.

Once the first iteration of the proposed business engineering model is validate, the *USIZO LOMUSA* Feeding Scheme will be expanded to supplementary South African schools in need of a feeding scheme.

2. The South African government

The South Africa government was identified as a potential stakeholder for the *USIZO LOMUSA* Feeding Scheme business engineering model, since the government is the sole funder of the currently implemented National School Nutrition Programme. Furthermore, the Government is known as the primary source of grants or financial assistance within South Africa.

Should the South African government decide upon funding the *USIZO LOMUSA* Feeding Scheme business engineering model, the process in which the *USIZO LOMUSA* Feeding Scheme will be expanded to supplementary schools in need of a feeding scheme will surely be increased. This would imply that a large number of the children will be reached within a short period of time.

3. Solidarity

For the purpose of the *USIZO LOMUSA* Feeding Scheme business engineering model Solidarity were identified as a prospective stakeholder, due to the fact that Solidarity is capable of easily identifying South African schools in great need for a feeding scheme.

Likewise, the number of previously described special manufactured houses imported from France, which were constructed within the informal settlements of Madadeni and Osizweni, were built as part of a Solidarity Holidays project.

4. MySchool card

The MySchool card champagne, currently enables approximately six hundred thousand (600 000) South Africans to nominate their favourite school and/or charity as a beneficiary. Should the proud owner of a MySchool card purchase a product from one of the participating MySchool campaign retailers, the card will be swiped that will automatically imply that a small percentage of the transaction is donated towards the previously indicated beneficiary. The MySchool card, is free of charge.

The possibility of listing the *USIZO LOMUSA* Feeding Scheme as one of the beneficiaries of the MySchool card champagne will definitely be investigated.

5. Companies

Investment opportunities with regard to the *USIZO LOMUSA* Feeding Scheme business engineering model, are available to all South African companies within both the public- and private sector. Due to the recently implemented legislation regarding B-BBEE in South Africa, which entails the dti's Broad-Based Black Economic Empowerment Act (2003/2004) together with the Codes of Good Practice, the *USIZO LOMUSA* Feeding Scheme business engineering model can be regarded as an excellent investment alternative.

The *USIZO LOMUSA* Feeding Scheme business engineering model is not only restricted to South African companies as stakeholders. The investment opportunity can also be considered by of international companies.

6. Private stakeholders

Private stakeholders within the context of the *USIZO LOMUSA* Feeding Scheme business engineering model include families and/or individuals who are capable of making a once off- or regular imbursement(s) in the form of a donation or sponsorship, towards the specific community orientated initiative. Else, as previously stated, contributions can be made through physical assistance, goods or products.

6.1.3 Implementation

The implementation of the complete *USIZO LOMUSA* Feeding Scheme business engineering model will be performed in three combined stages, each representing a division of the business engineering model. The three divisions include the stationary agricultural garden, the stationary kitchen facility and the mobile kitchen unit. The detailed implementation procedure and -schedule, related to the *USIZO LOMUSA* Feeding Scheme business engineering model will be exploited within the subsequent sub-sections.

1. Implementation procedure

The procedure derived for the successful implementation of the complete *USIZO LOMUSA* Feeding Scheme business engineering model, will be discussed using sequential steps for each of the business engineering model divisions previously mentioned.

1.1   Stationary agricultural garden

The activities related to the development of the initial stationary agricultural garden infrastructure will be outsourced to a professional in that particular field. Therefore, the actual implementation procedure may deviate from the process steps provided bellow.

1. The entire terrain of the model specific primary school, allocated for the use of the complete *USIZO LOMUSA* Feeding Scheme stationary agricultural garden, have to be properly fenced. The fence has to contain the prescribed gates enabling tractors to enter the specific workplace if needed.

2. Thereafter the complete enclosed terrain have to be ploughed to allow air within the soil.

3. A sample of the stationary agricultural garden soil have to be taken, in order to establish which manure would be ideal for the specific soil type.

4. Once the ideal compost is established, the relevant compost will be worked into the soil.

5. The allocated terrain will be left unutilized for a specified period of time, where after predetermined fertilizers will be used to control weed.

6. This step entails the formation of the raised beds according to the layout specifically designed for the purpose of the *USIZO LOMUSA* Feeding Scheme stationary agricultural garden.

7. The prescribed *USIZO LOMUSA* Feeding Scheme irrigation system have to be installed within the stationary agricultural garden. This step may be executed simultaneously with either of the preceding steps.

8. Once the raised beds were created and a second period of time elapsed, where after the weed were once again brought under control, the stationary agricultural garden related to the *USIZO LOMUSA* Feeding Scheme is ready for the imbedding of the numerous vegetable- and/or crop types.

1.2   Stationary kitchen facility

1. The facility at the model specific primary school, allocated for the use of the complete *USIZO LOMUSA* Feeding Scheme stationary kitchen facility, have to be inspected with regard to available equipment and tools.

2. The relevant facility have to be properly cleaned and disinfected, according to the standards specified within the *quality assurance* segment of the *production* sub-section.

3. The outstanding features, previously stipulated for the successful operation of the *USIZO LOMUSA* Feeding Scheme stationary kitchen facility, have to be installed.

4. All relevant equipment and tools prescribed for the *USIZO LOMUSA* Feeding Scheme stationary kitchen facility, have to be purchased and positioned in the relevant positions specified by the advanced development of the stationary kitchen facility layout.

1.3   Mobile kitchen unit

1. Due to the fact that the manufacturing of the mobile kitchen unit related to the *USIZO LOMUSA* Feeding Scheme business engineering model will be outsourced, an order have to be placed for the manufacturing of the specific mobile kitchen unit. It is of utmost importance to recognise lead time of the relevant manufacturer appointed for the production of the specific unit.

2. The fixed equipment included in the design of the mobile kitchen unit, will be installed at the manufacturer appointed for the production of the specific unit.

3. When the relevant mobile kitchen unit is received from the appointed manufacturer, the facility have to be properly cleaned and disinfected, according to the standards specified within the *quality assurance* segment of the *production* sub-section.

2.   Implementation schedule

The Gantt Chart in Figure 55, represents the implementation schedule that was specifically developed for the first iteration of the *USIZO LOMUSA* Feeding Scheme at the Blaauwbosch Primary school and the specified surrounding schools. The specific implementation schedule will serve as a guideline for the future expansion of the *USIZO LOMUSA* Feeding Scheme business engineering model.

The relevant student responsible for the execution of the *USIZO LOMUSA* Feeding Scheme business engineering model, predicts that the *USIZO LOMUSA* Feeding Scheme project will reach self-sustainability after three months from the complete implementation date. However, it may depend on the time of the year, the business model is implemented.

Implementation Gantt Chart
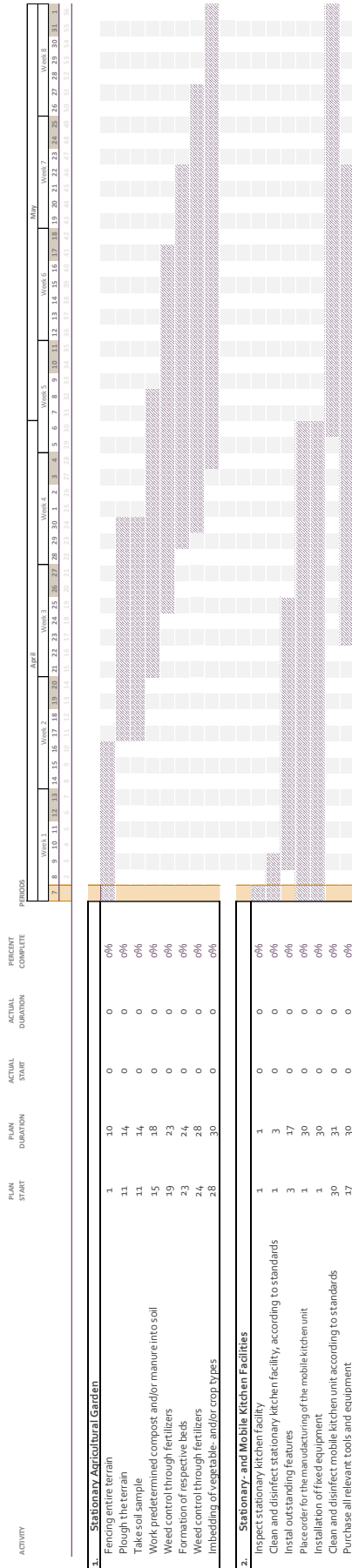
Figure 55 Gant Chart representing the preliminary implementation schedule

6.1.4 Financial considerations

Research related to all the financial considerations of the *USIZO LOMUSA* Feeding Scheme business engineering model were conducted. The preliminary figures associated with the implementation- and the sustainable operations of the first iteration of the *USIZO LOMUSA* Feeding Scheme business engineering model, were tabulated using Microsoft Office Excel. The relevant results can be examined within Table 25 bellow, although all the products and goods are excluded at this point in time.

The spaces allocated in red specifies the outstanding amounts, which will be provided by the closest local supplier applicable to the first iteration of the *USIZO LOMUSA* Feeding Scheme business engineering model. The student is currently busy with negotiations with the relevant Shoprite store, in order to settle on a price that is favourable for both parties. Once negotiates has reached consensus, the relevant amounts will be inserted into both the mathematical model and the cost estimate financial consideration table.

Table 25   Preliminary cost estimates related to the *USIZO LOMUSA* Feeding Scheme business engineering model

USIZO LOMUSA Feeding Scheme business engineering model cost estimates related to the first iteration

Division	Description	Cost (ZAR)	
Overall Accumulating Costs:		R	50 187.39
	Salaries - domestic workers in area A (1 618.37 ZAR per month)	R	24 437.39
	Training (per month)	R	6 250.00
	PPE - clothing and shoes (per year)	R	4 500.00
	Disaster management (per month)	R	-
	Replacement of equipment (per year)	R	15 000.00
Stationary Agricultural Garden:		R	48 500.00
	Initial infrastructural costs (compost/manure, fertilizers and so forth)	R	15 000.00
	Fencing (calcultated @ 80 ZAR per metre)	R	16 000.00
	Plastic chairs of 30 cm in hight (per year)	R	900.00
	Hats (per year)	R	1 500.00
	JoJo tanks - 2200l	R	4 400.00
	Water infrastructure (hosepipes, taps, sprayers and so forth)	R	3 000.00
	Valley for water transfer to JoJo tanks	R	1 500.00
	Fertilizer spraying equipment (per year)	R	3 200.00
	Agricultural equipment (forks, hoes, rakes and so forth) (per year)	R	3 000.00
Stationary Kitchen Facility:		R	11 150.00
	Cooking equipment and tools	R	6 000.00
	Comfortable chairs	R	1 950.00
	Cleaning equipment	R	2 000.00
	Cleaning substances (per month)	R	1 200.00
Mobile Feeding Kitchen:		R	214 800.00
	Initial infrastructural costs - trailer	R	100 000.00
	Petrol expense (per month)	R	111 600.00
	Equipment and tools	R	2 000.00
	Cleaning substances	R	1 200.00
Mathematical Model:	Requirements (per month)	🟥	
Procurement:			
	Products and goods (per month)	🟥	
	TOTAL estimated initial expense	**R**	**324 637.39**

174

6.1.5 Possible franchise registration

For the purpose of concluding the *USIZO LOMUSA* Feeding Scheme business engineering model, the student considered the requirements related to the registration of a franchise within South Africa.

There are several rules and regulations for the registration of a franchise. The membership criteria related to franchisors, stated by the FASA, include the approval of applications by the FASA membership committee.

The criteria used by the FASA membership committee, with respect to the consideration of each applicant company, includes the viability of the concept and the presence of all appropriate documentation mentioned within the *post development* sub-section of the *literature review* section. Furthermore, a company is only entitled to full membership, if the relevant franchise concept were successfully operating within South Africa for at least two years.

Thus, the business engineering model related to the *USIZO LOMUSA* Feeding Scheme will be validated at the Blaauwbosch Primary school and the neighbouring schools, as a first iteration. The *USIZO LOMUSA* Feeding Scheme business engineering model will be patented for the purpose of the extending the concept to supplementary South African schools, where after the possibility of registering the business engineering model as a franchise will only be considered once the relevant model was successfully operating for two successive years.

7   Conclusion

In conclusion, the *USIZO LOMUSA* Feeding Scheme business engineering model that were developed throughout the course of the sequential modules *Project* (BPJ 410) and *Project* (BPJ 420), is applicable to all South African schools in need of a stationary and/or mobile feeding scheme.

The student responsible for the development of the *USIZO LOMUSA* Feeding Scheme business engineering model will propose the relevant business engineering model to the ArcelorMittal Newcastle works management within the following month. Operations related to the implementation of the *USIZO LOMUSA* Feeding Scheme will commence once the relevant stakeholder approve.

The first iteration of the *USIZO LOMUSA* Feeding Scheme will be validated at the Blaauwbosch Primary school and the three supplementary schools early next year, which promises to provide food to three thousand and thirty four (3034) children. Once the business engineering model is validated and necessary adjustments were incorporated within the business engineering model, the *USIZO LOMUSA* Feeding Scheme business engineering model will be expanded to additional South African schools.

During the period in which the relevant business engineering model was developed, the student specifically addressed the business engineering model specifics, a balanced diet for children, the generation of a mathematical model to calculated the optimal solution with regard to the stationary agricultural garden inputs, standardized layouts for each of the three facilities included within the business engineering model, and lastly a fractional of the logistics and supply chain activities. A number of aspects related to the production, operations and support of the *USIZO LOMUSA* Feeding Scheme business engineering model were included within the post development section.

The first category related to the logistics and supply chain activities, along with the procurement schedule related to the *USIZO LOMUSA* feeding scheme, will be produced within the nearby future. The student intend to develop the procurement schedule using the lot sizes related to each of the specified goods and products included within the Tiny Tots Menu, which will be provided by the closest local supplier applicable to the first iteration of the *USIZO LOMUSA* Feeding Scheme business engineering model.

The relevant supplier is in this case the Shoprite store, situated at the Theku Plaza in Osizweni, which is approximately 1.2 kilometres (km) from Blaauwbosch Primary school. The student is currently busy with negotiations, in order to settle on a price that is favourable for both parties.

The procedure related to the first iteration- and the further expansion of the *USIZO LOMUSA* Feeding Scheme business engineering model, will be clearly defined once the relevant business engineering model is validate. Furthermore, the means of transportation used for the mobile kitchen unit will be investigated.

When one candle lights another, it will not lose its ability to produce light. Many candles (feeding schemes) will undoubtedly enlighten the lives of several children in need, thus the relevant student would like to encourage potential stakeholders to lead the way to a brighter and prosperous future.

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APPENDIX A

SIGNED INDUSTRY SPONSORSHIP FORM

Department of Industrial & Systems Engineering
Final Year Projects
Identification and Responsibility of Project Sponsors
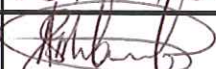
All Final Year Projects are published by the University of Pretoria on *UPSpace* and thus freely available on the Internet. These publications portray the quality of education at the University and have the potential of exposing sensitive company information. It is important that both students and company representatives or sponsors are aware of such implications.

Key responsibilities of Project Sponsors:

A project sponsor is the key contact person within the company. This person should thus be able to provide the best guidance to the student on the project. The sponsor is also very likely to gain from the success of the project. The project sponsor has the following important responsibilities:

1. Confirm his/her role as project sponsor, duly authorised by the company. Multiple sponsors can be appointed, but this is not advised. The duly completed form will considered as acceptance of sponsor role.
2. Review and approve the Project Proposal, ensuring that it clearly defines the problem to be investigated by the student and that the project aim, scope, deliverables and approach is acceptable from the company's perspective.
3. Review the Final Project Report (delivered during the second semester), ensuring that information is accurate and that the solution addresses the problems and/or design requirements of the defined project.
4. Acknowledges the intended publication of the Project Report on UP Space.
5. Ensures that any sensitive, confidential information or intellectual property of the company is not disclosed in the Final Project Report.

Project Sponsor Details:

Company:	ArcelorMittal Newcastle Works
Project Description:	Mobile Feeding Scheme Business Engineering Model
Student Name:	Anne Petronella (Anneri) Basson
Student number:	10038826
Student Signature:	
Sponsor Name:	S. Mntambo
Designation:	
E-mail:	Sipho.mntambo@arcelormittal.com
Tel No:	034 314 8228 / 034 314 8292
Cell No:	083 289 5997
Fax No:	034 314 8292
Sponsor Signature:	

APPENDIX B

WORK BREAKDOWN STRUCTURE

Mobile Feeding Scheme Business Engineering Model

Phase I — Design
- Diet
- Stationary agricultural garden
- Facilities design
- Supply chain
- Workplace design
- Procurement schedule
- Feasibility assessment

Phase II — Production
- ISO regulations
- Methods for manufacturing
- Manufacturers
- Quality assurance
- Legal documentation
- Construction and testing

Phase III

Operational Process Development
- Area specific variables
- Sustainable farming practices
- Legislation
- Training
- Balances scorecards
- Invoicing
- Disaster management

Other
- Patent
- Stakeholders
- Financial considerations
- Implementation
- Non-profit franchise

Figure 56 *USIZO LOMUSA* **Feeding Scheme work breakdown structure**

APPENDIX C

COMMITTEE FOR RESEARCH ETHICS AND INTEGRITY APPROVAL

Reference number: EBIT/12/2014   19 May 2014

Ms AP Basson
PO Box 35
Newcastle
2940

Dear Ms Basson,

FACULTY COMMITTEE FOR RESEARCH ETHICS AND INTEGRITY

Your recent application to the EBIT Ethics Committee refers.

1   I hereby wish to inform you that the research project titled "Mobile feeding scheme business engineering model" has been approved by the Committee.

This approval does not imply that the researcher, student or lecturer is relieved of any accountability in terms of the Codes of Research Ethics of the University of Pretoria, if action is taken beyond the approved proposal.

2   According to the regulations, any relevant problem arising from the study or research methodology as well as any amendments or changes, must be brought to the attention of any member of the Faculty Committee who will deal with the matter.

3   The Committee must be notified on completion of the project.

The Committee wishes you every success with the research project.

Prof JJ Hanekom
Chair: Faculty Committee for Research Ethics and Integrity
FACULTY OF ENGINEERING, BUILT ENVIRONMENT AND INFORMATION TECHNOLOGY

APPENDIX D

INFORMED CONSENT FORM FOR INTERVIEWS

USIZO LOMUSA

FEEDING SCHEME

Business Engineering Model

I_____(Name and Surname of interviewee), hereby voluntarily grant my permission for participation in the project as explained to me by Anneri Basson, the researcher of the project *USIZO LOMUSA*.

The nature, objective, possible safety and health implications have been explained to me

and I understand them.

I understand my right to choose whether to participate in the project and that the information furnished will be handled confidentially.

I am aware that the results of the investigation may be used for the purposes of publication.

Upon signature of this form, you will be provided with a copy.

Signed: _____   Date: _____

Witness: _____   Date: _____

Researcher: _____   Date: _____

APPENDIX E

INFORMED CONSENT FORM FOR QUESTIONNAIRES

USIZO LOMUSA
FEEDING SCHEME

Business Engineering Model

Dear Sir/Madam

I, Anneri Basson, am currently a final year Industrial Engineering student at the University of Pretoria. During our final year we have to complete a comprehensive project in which we need to apply the fundamental knowledge and techniques gained throughout the duration of our Bachelor's Degree.

The project *USIZO LOMUSA* entails the development of a business model that promises to provide several children with food, should the feeding scheme be approved and implemented within specific identified communities.

With this letter, I would like to ask your permission to hand out questionnaires to your child/children who are currently attending school at the Blaauwbosch Primary school. The information obtained from the questionnaires will be handled confidentially and contribute towards the *literature review* section of the *USIZO LOMUSA* project report.

The questionnaire that will be handed out to the pupils for completion, will be made available at the Blaauwbosch Primary school reception would you like to see the questions that will be asked.

The possibility that the final project report will be published surely exists, should a total mark above seventy five (75) be obtained for the project.

It will truly be appreciated if you as the parent or guardian could fill in the section on the second page of the letter of consent, should you approve the completion of the questionnaire by the relevant pupil.

Regard

Anneri Basson

I_____(Name and Surname of parent or guardian), voluntarily grant

permission on behalf of my child,

_____(Name and Surname of child),

to participate in the project as explained to me in the letter of consent.

I understand my right to choose whether my child is to participate in the project and that the information furnished will be handled confidentially.

I am aware that the results of the investigation may be used for the purposes of publication.

Signed: _____(parent or guardian) Date: _____

APPENDIX F

QUESTIONNAIRE

USIZO LOMUSA
FEEDING SCHEME

What is your age?
Uneminyaka emingaki? _____

In what grade in school, are you currently?
Ukuliphi ibanga esikoleni,njengamanje?

1	2	3	4	5	6	7	8	9	10	11	12

How many children live in your house?
Bangaki abantwana abahlala endlini yakini?

1	2	3	4	5	6	7	8	9	10	more

How many children in your home, go to school?
Bangaki abantwana emzini wakini, abahamba isikole?

1	2	3	4	5	6	7	8	9	10	more

Who takes care of you at home?
Unakekelwa ngubani ekhaya?

Mother	Father	Aunt	Uncle	Grandmother	Grandfather	Other

Umama	Ubaba	U-Anti	Umalume	Ugogo	Umkhulu	Omunye

Who does the cooking at home?
Ngubani ophekayo ekhaya?

Mother	Father	Aunt	Uncle	Grandmother	Grandfather	Other

Umama	Ubaba	U-Anti	Umalume	Ugogo	Umkhulu	Omunye

How many times in a week do you eat meat?
Uyidla kangaki inyama ngeviki?

1	2	3	4	5	6	7	8	9	10	more

How many times in a week do you eat a fruit or vegetable?
Udla kangaki isithelo noma umfino ngeviki?

1	2	3	4	5	6	7	8	9	10	more

Do you have a favourite meal?

Ingabe unakho ukudla okuthanda kakhulu?

Yes	No

Yebo	Cha

If yes, what would that meal be?

Uma yebo, ubungathi yikuphi lokho kudla?

_____

What is your favourite fruit?

Yisiphi isithelo osithanda kakhulu?

_____

What is your favourite vegetable?

Yimuphi umfino owuthanda kakhulu?

_____

Do you have a vegetable garden at home?

Ingabe unayo ingadi (yemifino) ekhaya?

Yes	No

Yebo	Cha

If yes, who looks after the vegetable garden?

Uma yebo, ngubani onakekela le ngadi yemifino?

Mother	Father	Aunt	Uncle	Grandmother	Grandfather	Other

Umama	Ubaba	U-Anti	Umalume	Ugogo	Umkhulu	Omunye

APPENDIX G

NEWCASTLE DISTRICT LISTED SCHOOLS

Table 26 is an extraction of the researched table indicating all the schools listed within the province of KwaZulu Natal. The extraction only displays the Newcastle District listed schools.

Table 26 Newcastle District listed schools

no.	Newcastle District schools
1	AMADADA S
2	AMAHOBE PRIMARY
3	AMAJUBA HIGH
4	AMAZULU HIGH
5	ANNIEVILLE SP
6	ARBOR PRIMARY ARK PRIMARY
7	BALLENGEICH C
8	BETHAMOYA HIGH
9	BLAAUWBOSCH PRIMARY
10	BOTHA'S PRIMARY ASS FARM PRIMARY
11	BUHLE BE-ALLEN PRIMARY
12	BUHLEBENTUTHUKO PRIMARY
13	BUHLEBOMZINYATHI S
14	BUSY BEE PRIMARY
15	CACA PRIMARY
16	CACAMEZELA S
17	CATHULANI PRIMARY
18	CEBELIHLE PRIMARY
19	CELA C
20	CHELMSFORD PRIMARY
21	COOPER PRIMARY
22	DEDANGIFUNDE HIGH
23	DRAKENSBERG PRIMARY
24	DUCK PRIMARY ONDS SS
25	EMBABANE PRIMARY
26	EMPONDO FARM PRIMARY
27	EMTHUNZINI PRIMARY
28	EMXHAKENI PRIMARY
29	ENGODINI PRIMARY
30	ENHLOKWENI PRIMARY
31	ENHLONIPHWENI SP
32	ENKULULEKWENI PRIMARY
33	ESIDIDINI PRIMARY
34	EZAMAKHANYA PRIMARY
35	EZINCWADINI SP
36	FAITH CHRISTIAN
37	FERRUM HIGH
38	GARDENS PRIMARY
39	GIJIMANI PRIMARY
40	GLENCALDER PRIMARY

41	HAIG PRIMARY
42	HILLTOP PRIMARY
43	HLABANA PRIMARY
44	HLALANATHI HIGH
45	HLALUNOLWAZI PRIMARY
46	HOPE HIGH
47	HUTTENPARK PRIMARY
48	IKHWEZI HIGH
49	INDONI JP
50	INDONSA S
51	INGABADE HIGH
52	INGOGO PRIMARY
53	INGWE PRIMARY
54	INVERNESS PRIMARY
55	ISIKHALISEZWE HIGH
56	ISLAMIC COLLEGE NEWCASTLE
57	IZIKO PRIMARY
58	JOBSTOWN PRIMARY
59	KHALIMA PRIMARY
60	KHASELIHLE JP
61	KHETHUKUTHULA S
62	KHIPHOKUHLE HIGH
63	KHULAKAHLE JP
64	KILBARCHAN PRIMARY
65	KOENIGSBERG PRIMARY FARM
66	KWETHU JP
67	LENNOXTON PRIMARY
68	LETHUKUTHULA PRIMARY
69	LINCOLN HIGH EIGHTS S
70	LINDOKUHLE PRIMARY
71	LINGANI PRIMARY
72	MAHLEKEHLATHINI PRIMARY FARM
73	MANA HIGH
74	MANDLAMASHA PRIMARY
75	MASIHAMBISANE PRIMARY
76	MATA PRIMARY
77	MBALENHLE SP
78	MBUKENI SP
79	MDUMISENI HIGH
80	MLAMLELI JP
81	MLONDOLOZI SP
82	MNTIMANDE PRIMARY
83	MNYAMANDE S
84	MULLERSPASS FARM PRIMARY
85	MUZIKAYISE PRIMARY
86	MUZOKHANYAYO S

87	MZAMO HIGH
88	NCANDU C
89	NDABANHLE PRIMARY (OSIZWENI)
90	NEWCASTLE HIGH
91	NEWCASTLE SP
92	NHLOSOKUHLE S
93	NKABANE PRIMARY (LADYSMITH REGION)
94	NOKUKHANYA PRIMARY
95	NTENDEKA PRIMARY
96	OSIZWENI HIGH
97	PANORAMA HIGH
98	PHAMBILI PRIMARY
99	PHATHAKAHLE HIGH
100	PHENDUKANI HIGH
101	PHIKELELA SP
102	PHUZUKUBONA PRIMARY UBLIC S
103	QAPHELANI JP
104	QEDIZABA JP
105	QHUBEKA SP
106	QHUBIMFUNDO C
107	QHUBIMFUNDO JP
108	QOPHUMLANDO SP
109	S.E. VAWDA PRIMARY
110	SABELA HIGH
111	SATHYA SAI NEWCASTLE
112	SEBASTOPOL PRIMARY
113	SEBENZANI PRIMARY
114	SEKUSILE SS
115	SESIYABONGA HIGH
116	SGODIPHOLA PRIMARY
117	SIKHONA PRIMARY
118	SIMANGANYAWO PRIMARY
119	SIPHENI HIGH P
120	SIPHESIHLE PRIMARY
121	SIPHUMELELE JP
122	SISIZAKELE PRIMARY
123	SISONKE PRIMARY
124	SITHOBELUMTHETHO SP
125	SIYALUNGELWA S
126	SIYATHUTHUKA PRIMARY
127	SIZAKANCANE JP
128	SIZAMOKUHLE PRIMARY
129	SIZANANI SS
130	SIZWE PRIMARY
131	SLANGRIVIER PRIMARY
132	SONDELANI PRIMARY

133	SOSINDA PRIMARY
134	SOUTHFIELDS PRIMARY
135	ST DOMINIC'S ACADEMY
136	ST LEWIS BERTRAND'S S
137	ST OSWALD'S S
138	SURYAVILLE PRIMARY
139	THATHUNYAWO S
140	THEMBALENTSHA HIGH
141	THIYASIZWE PRIMARY
142	THOBANI SP
143	THUBELIHLE HIGH
144	UMCEBOWOLWAZI SP
145	V. S. ZULU PRIMARY
146	VERDRIET PRIMARY
147	VUKANI JP
148	VULINDLELA PRIMARY
149	VUMELANI PRIMARY
150	XOLANI HIGH
151	ZABALAZA INT S
152	ZIBAMBELENI S
153	ZIPHAKAMISENI PRIMARY UBLIC S
154	ZIZUZELE PRIMARY
155	ZUZA JP

APPENDIX H

RECIPES APPLICABLE TO THE DIET FORMULATED BY THE DIETITIAN

1st m Monday

Kraft

One-Dish Chicken Broccoli Bake

time

prep:	total:
15 min	50 min

servings

total:
6 servings

what you need

1-1/2	lb.	boneless skinless chicken breasts, cut into bite-size pieces
3	cups	instant white rice, uncooked
3	cups	milk
1/2	lb.	(8 oz.) VELVEETA®, cut into 1/2-inch cubes
1	pkg.	(10 oz.) frozen chopped broccoli, thawed, drained
1/2	cup	~~MIRACLE WHIP Dressing~~

make it

HEAT oven to 375°F.

MIX all ingredients in 13x9-inch baking dish.

BAKE 35 min. or until chicken is done.

STIR before serving.

kraft kitchens tips

SUBSTITUTE
Substitute KRAFT Real Mayo Mayonnaise for the dressing.

VARIATION
Prepare using 2% Milk VELVEETA and MIRACLE WHIP Light Dressing.

servings
total:
6 servings

nutritional info per serving
per serving

Calories	520	Total fat	17 g	Saturated fat	8 g
Cholesterol	105 mg	Sodium	760 mg	Carbohydrate	50 g
Dietary fiber	2 g	Sugars	12 g	Protein	39 g
Vitamin A	25 %DV	Vitamin C	25 %DV	Calcium	50 %DV
Iron	20 %DV				

K:47637v1:144924

Dinsdag (1ste) Tuesday
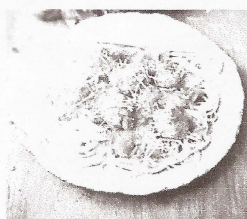
Cooking with kids: Spaghetti & meatballs with hidden veg

Cooking time
Prep: 15 mins
Cook: 30 mins

Skill level
Easy

Servings
Serves 6 (4 children, adults)

Nutrition *per serving*

kcalories	protein	carbs	fat	saturates	fibre	sugar	salt
388	31.3g	10.2g	24.7g	9.4g	2.5g	7.2g	1.5g

Ingredients

For the meatballs

300g good quality pork sausages (about 4 large or 8 chipolatas)

500g lean beef mince

1 small onion, coarsely grated

1 carrot, finely grated

1 tbsp dried oregano

50g Parmesan, finely grated, plus extra to serve

1 medium egg

1 tbsp olive oil

For the tomato sauce

1 tbsp olive oil

Method

1. Children: Squeeze all the sausage meat out of the sausage skins into a large bowl and add the mince. Tip all the rest of the meatball ingredients, except the olive oil, into the bowl and season with black pepper then squish everything together through your hands until completely mixed. Keep an eye on younger children to make sure they don't taste any of the raw mix.

2. Children: Roll the meatball mix into walnut-sized balls and place them on a plate – this is a job children as young as 2 can help with and a great job to help teach older children basic division.

1 courgette, coarsely grated

3 garlic cloves, finely grated

1 tbsp tomato purée

pinch caster sugar

splash red wine vinegar

2x 400g tins chopped tomatoes

To serve

cooked spaghetti

Tip

Tip for cooking with kids

Before you start tie back any long hair, put on your aprons and wash your hands. Make sure your child is stable where they are cooking and comfortable with the angle they are cooking at. As you cook explain what the different ingredients are and where they come from.

3.   Grown ups: While the children are rolling the meatballs make the sauce. Heat the oil in a large saucepan. Add the courgette and garlic and cook for 5 mins until soft and mushy. Stir in the tomato puree, sugar and vinegar leave for 1 min then tip in the tomatoes and simmer for 5 mins. If your children like courgettes then you can leave the sauce chunky. But if, like mine, they hate courgettes then blitz the sauce with a hand blender – either way continue to simmer sauce gently while you cook the meatballs. If your child is confident with heat, from 7+ they can cook the sauce with supervision.

4.   Grown ups: Heat the oil in a large frying pan and, working in batches, brown the meatballs on all sides then pop them into the sauce – continue to simmer the sauce for 15 mins, stirring very gently until the meatballs are cooked through. Serve with cooked spaghetti, extra grated Parmesan and a few torn basil leaves your child has picked and torn.

1st Wednesday / Woensdag

(Kraft)

Fish Cakes

time

prep:
5 min

total:
1 hr 11 min

servings

total:
6 servings, 2 fish cakes each

what you need

Take 1 pkg. (6 oz.) STOVE TOP Stuffing Mix for Chicken, 3/4 cup water and 1/3 cup KRAFT Real Mayo Mayonnaise and mix & match your recipe from these options...

fish options	add-in choices	vegetable possibilities
2 cans (6 oz. each) crabmeat, drained, flaked	3 Tbsp. KRAFT Tartar Sauce	finely chopped celery
2 cans (5 oz. each) salmon, drained, skin and bones discarded	1 Tbsp. lemon juice, 1 cup KRAFT Shredded Mozzarella Cheese	chopped green onions
2 cans (5 oz. each) tuna, drained, flaked	2 Tbsp. CLAUSSEN Sweet Pickle Relish, 1 cup KRAFT Shredded Cheddar Cheese	shredded carrots
3 cans (4 oz. each) tiny cooked shrimp, drained	1/4 cup KRAFT Barbecue Sauce	finely chopped green peppers

then follow our 3 simple steps:

MIX stuffing mix, water, mayo, **fish, add-ins** and 1/2 cup **vegetables**. Shape into 12 patties, using about 1/3 cup stuffing mixture for each patty; cover. Refrigerate 1 hour.

HEAT large nonstick skillet sprayed with cooking spray on medium heat. Add patties to skillet in batches.

COOK 6 min. or until golden brown on both sides, turning carefully after 3 min.

kraft kitchens tips

MAKE AHEAD
Patties can be shaped ahead of time. Cover and refrigerate up to 24 hours before cooking as directed.

HOW TO MAKE SAME-SIZE PATTIES
Use a hamburger press to make evenly sized patties.

SPECIAL EXTRA
Serve with KRAFT Cocktail Sauce or KRAFT Tartar Sauce.

servings
total:
6 servings, 2 fish cakes each

Nutrition Information

1st Wednesday

Kraft

Spicy Sweet Potato Wedges

healthy living

time

prep:
15 min

total:
43 min

servings

total:
4 servings

what you need

1		egg
1	pkt.	SHAKE 'N BAKE Chicken Coating Mix
1	Tbsp.	brown sugar
1/4	tsp.	ground red pepper (cayenne)
1	lb.	sweet potatoes (about 2), peeled, cut into 1/2-inch-thick wedges

make it

HEAT oven to 425°F.

BEAT egg in shallow dish until well blended. Mix next 3 ingredients in medium bowl until well blended.

DIP potatoes in egg, then in coating mixture, turning to evenly coat each wedge. Place in single layer in shallow foil-lined pan sprayed with cooking spray.

BAKE 25 to 28 min. or until potatoes are tender.

kraft kitchens tips

FOOD FACTS
The sweet potato has been called a "superfood", since it is a good source of both fiber and potassium, and high in both vitamins A and C.

SWEET POTATO OR YAM?
Although Americans often refer to sweet potatoes as yams, true yams are not heavily marketed in the United States. There are many varieties of sweet potatoes, but just two of those are widely available. One has a thin, light yellow skin and pale yellow flesh which becomes dry and crumbly when cooked. The other is often erroneously referred to as a yam. It has a thicker, dark orange skin and a bright orange flesh that becomes moist when cooked. Bright orange potatoes sold in cans and labeled as yams are actually sweet potatoes.

servings
total:
4 servings
healthy living information
Good source of fiber
Good source of vitamin A or C
diet exchange
2-1/2 Starch
nutrition bonus
Just five ingredients are needed to make these potato wedges with a twist. As an added bonus, the sweet potato is rich in vitamin A and a good source of fiber.

mealie pap, Thursday

Spark Recipes - eat better   (2014)

mealie pap

Ingredients

1 cup polenta
4 cups water
0.5 tsp salt

Directions

mix polenta with water and salt, stir till it comes to boil,
turn heat down very low, simmer for 10 minutes.

Number of Servings: 4

Recipe submitted by SparkPeople user SUBICK.

Nutrition Info

Calories: 41.7	
Fat: 0.1g	
Carbohydrates: 9.2g	
Protein: 1.0g	

1st Friday

Kraft

BOCA Hawaiian Pizza

time

prep: total:
10 min   20 min

servings

total:
6 servings

what you need

1		ready-to-use baked pizza crust (12 inch)
1/4	cup	KRAFT Original Barbecue Sauce
1	cup	frozen BOCA Veggie Ground Crumbles
1/2	cup	KRAFT Pizza Shredded Low-Moisture Mozzarella & Cheddar Cheeses
1/4	cup	drained canned pineapple tidbits
1/3	cup	green pepper strips
1/3	cup	sliced red onions

make it

HEAT oven to 450°F.

PLACE pizza crust on baking sheet; spread with sauce.

TOP with remaining ingredients.

BAKE 10 min. or until crumbles are heated through (160°F) and cheese is melted.

kraft kitchens tips

VARIATION
Cook 4 BOCA Breakfast Links as directed on package; cut into 1/4-inch-thick slices, then use instead of the crumbles.

SUBSTITUTE
Prepare using a whole wheat pizza crust or 2 (6-inch) pizza crusts.

SUBSTITUTE
Prepare using BULL'S-EYE Original Barbecue Sauce.

servings
total:
6 servings
healthy living information
Diabetes Center
carb choices
carb choices:
2
diet exchange
2 Starch + 1-1/2 Fat
nutrition bonus
This delicious oh-so-easy pizza, made with meatless crumbles, is sure to become a new family favorite.

2nd Monday

Kraft

Speedy Tuna "Casserole"
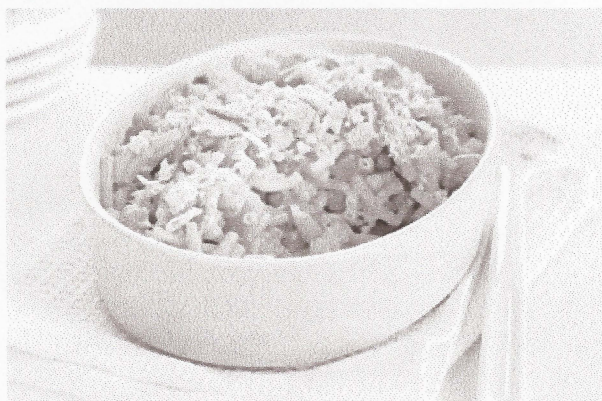
time

prep:
20 min

total:
20 min

servings

total:
4 servings, 1-1/4 cups each

what you need

1	pkg.	(7-1/4 oz.) KRAFT Macaroni & Cheese Dinner
1	cup	frozen mixed vegetables (carrots, corn, peas)
1	can	(5 oz.) white tuna in water, drained, flaked
8		RITZ Crackers, crushed (about 1/3 cup)

make it

PREPARE Dinner in large saucepan as directed on package, adding vegetables to the boiling water for the last 2 min.

ADD tuna; mix lightly.

TOP with cracker crumbs.

kraft kitchens tips

SERVING SUGGESTION
Serve with a crisp mixed green salad tossed with your favorite KRAFT Lite Dressing.

SUBSTITUTE
Substitute 1/4 cup French fried onion rings for the cracker crumbs.

servings
total:
4 servings, 1-1/4 cups each

nutritional info per serving

per serving

Calories	380	Total fat	14 g	Saturated fat	3 g
Cholesterol	20 mg	Sodium	720 mg	Carbohydrate	42 g
Dietary fiber	2 g	Sugars	2 g	Protein	15 g
Vitamin A	20 %DV	Vitamin C	0 %DV	Calcium	15 %DV
Iron	10 %DV				

K:53411v0:109518

2nd Tuesday

taste.com.au

taste | coles
Great recipes start with great ingredients.

Minestrone soup

0:20
To Prep

1:00
To Cook

6
SERVINGS

A low-fat, vegetarian minestrone soup to keep you warm on a cold winter's night.

Ingredients

- ☐ 1 400g can diced peeled tomatoes
- ☐ 3 pontiac potatoes, peeled, chopped
- ☐ 200g piece jap or butternut pumpkin, deseeded, peeled, chopped
- ☐ 1 large brown onion, chopped
- ☐ 2 carrots, chopped
- ☐ 2 celery sticks with leaves, chopped
- ☐ 1 large garlic clove, chopped
- ☐ 1 teaspoon dried oregano leaves
- ☐ 1.75L (7 cups) water
- ☐ 3 small or 2 large zucchini, chopped
- ☐ 40g (1/4 cup) small macaroni
- ☐ 1 400g can borlotti beans, rinsed, drained
- ☐ 1/2 cup firmly packed roughly chopped fresh continental parsley
- ☐ Salt & freshly ground black pepper
- ☐ 1 1/2 tablespoons extra virgin olive oil
- ☐ 20g parmesan or vegetarian hard cheese, finely shredded

Method

1. Place the tomatoes, potatoes, pumpkin, onion, carrots, celery, garlic and oregano in a large saucepan.

2. Stir in the water and bring to the boil over medium-high heat. Reduce heat to medium and cook, almost covered, for 45 minutes.

3. Add the zucchini and macaroni, and cook, stirring occasionally, for 10 minutes. Stir in the beans and cook for a further 5 minutes or until the zucchini and pasta are tender.

4. Stir in the parsley and taste and season with salt and pepper. Ladle into serving bowls. Drizzle with the olive oil, sprinkle with the parmesan and serve immediately.

2nd Wednesday (handwritten)

Cottage Pie

By Az B on May 10, 2010

★ ★ ★ ★ ★   2 Reviews

Prep Time: 30 mins   **Total Time:** 1 hrs   **Serves:** 4, **Yield:** 4

Photo by Tea Jenny

About This Recipe

"from www.britainexpress.com."
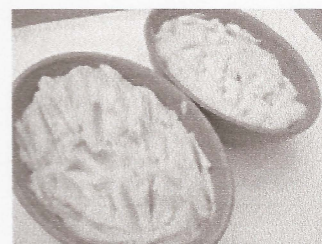
Ingredients

- 1 lb ground beef
- 1 yellow onion
- 1 vegetable bouillon cube
- 1/2 cup peas (can be frozen)
- 6 large baking potatoes
- ~~1 -2 teaspoon browning sauce (optional)~~
- 2 tablespoons cornstarch
- 2 tablespoons cold water
- milk (to taste)
- butter (to taste)

Directions

1. Peel and chop up the potatoes into large chunks and put on too boil in a pot. This will take about 20 minutes. While the potatoes are cooking, you can start cooking the meat.

2. Chop up the onion and fry in a pan until almost golden brown. Add the ground beef and break it all up and cook until no longer red in colour.

3. Turn on the oven and preheat a deep baking dish in there.

4. Add the vegetable cube and make sure it is broken up and mixed inches

5. Throw in the peas and mix them into the meat and continue to simmer. At this point, you can add a teaspoon or two of browning or seasoning sauce to the meat, and tip in some of the water from the potatoes. Keep simmering the meat in the pan.

6. The potatoes should be almost cooked - you can test them by sticking a knife into them. If the knife sinks in easily, they're done. Pour off the water and save some of it in case you need more for the meat / sauce.

7. Mix up two tablespoons of corn-starch with two tablespoons of cold water in a saucer. When it's all mixed into a white liquid, pour this into the meat and stir in quickly. The water in the dish will thicken, continue to simmer and stir occasionally to make sure the corn-starch is cooked through.

2ⁿᵈ Wednesday

4 LIVING

Easy recipes and a helping of fun from home cooks like you.

Green Bean Sticks

My mother made this a lot when I was young. Coming from a family of ten, she had a very creative way of cooking.

Shared by

Ingredients

- 2 cans green beans
- 1 C. flour
- 2 eggs
- 2 Tbs. butter

Directions

Drain beans. Beat eggs in small bowl. Dip beans in egg mixture and dredge in flour. Melt butter in large fry pan on medium heat. Add beans and saute until golden brown.

2nd Thursday

Umqusho

By lluv2cook59 on June 26, 2007

Food.com

Home of the Home Cook

★★★★☆ 1 Reviews

🕐 **Prep Time:** 48 hrs   **Total Time:** 48 hrs   **Servings:** 8-10
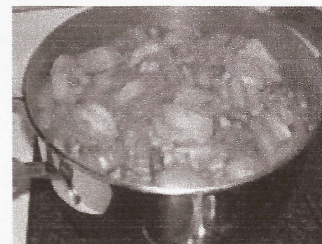
Photo by lluv2cook59

About This Recipe

"This recipe has been tried and tested in my kitchen from "one" of my favourite recipe books that my mom sent me from South Africa. "you super winning recipes" by Carmen Niehaus. Luckily I managed to find the samp and beans in a nearby south african shop. This dish takes a long time to prepare taking in the consideration of soaking the samp and beans, but, this could be even used to make a "potjie". I have made this with chicken and beef, but penultimately, lamb is far the best tasting."

Ingredients

500 ml samp

250 ml speckled sugar beans

1 teaspoon salt (1 tsp)

1 teaspoon pepper (1tsp)

12 1/2 ml oil

2 onions, sliced

1 green pepper, sliced

4 fresh garlic cloves, crushed

12 pieces mutton neck or 12 pieces lamb

2 tomatoes, skinned and chopped

6 small potatoes, peeled

100 g carrots

15 ml curry powder

25 ml turmeric

1 chicken stock cube, dissolved in

500 ml boiling water

Directions

1. Soak the samp and beans in cold water overnight. Drain and place in a heavy based saucepan with 1 litre of water. Boil until tender and season with salt and pepper.(the samp cooking directions above).

2nd Thursday

Betty Crocker

View Recipe

Impossibly Easy Pumpkin Pie

Volunteer to bring the pumpkin pie this Thanksgiving. This recipe is a snap--no crust to make!

Prep Time	Total Time	Servings
10 min	4 hr 20 min	6

- 1   cup canned pumpkin (not pumpkin pie mix)
- 1/2   cup Original Bisquick™ mix
- 1/2   cup sugar
- 1   cup evaporated milk
- 1   tablespoon butter or margarine, softened
- 1 1/2   teaspoons pumpkin pie spice
- 1   teaspoon vanilla
- 2   eggs

Whipped topping, if desired

1. Heat oven to 350ºF. Grease 9-inch pie plate.

2. Stir all ingredients except whipped topping until blended. Pour into pie plate.

3. Bake 35 to 40 minutes or until knife inserted in center comes out clean. Cool 30 minutes. Refrigerate about 3 hours or until chilled. Serve with whipped topping. Store covered in refrigerator.

To lower the fat to just 4 grams and the calories to 170 per serving, use 1 1/2 cups of 1% milk for the evaporated milk and use reduced-calorie margarine.

For a festive presentation, sprinkle the plate with ground cinnamon. Top the pie with frozen (thawed) whipped topping and a cinnamon stick.

If you don't have pumpkin pie spice on hand, use 1/2 teaspoon each of ground cinnamon, ground nutmeg and ground ginger.

Nutrition Information

Serving Size: 1 Serving Calories 215 (Calories from Fat 70), **% Daily Value** Total Fat 9 g 9 % (Saturated Fat 4 g, 4 %), Cholesterol 90 mg 90 %; Sodium 220 mg 220 %; Total Carbohydrate 31 g 31 % (Dietary Fiber 1 g 1 %), Protein 6 g 6 % ; **% Daily Value*:** Vitamin A 96%; Vitamin C 2%; Calcium 14%; Iron 6%; **Exchanges:** 2 Starch; 1 Fat; *Percent Daily Values are based on a 2,000 calorie diet.*

2nd Friday

Kraft

Sizzlin' Chipotle Cheddar Burger
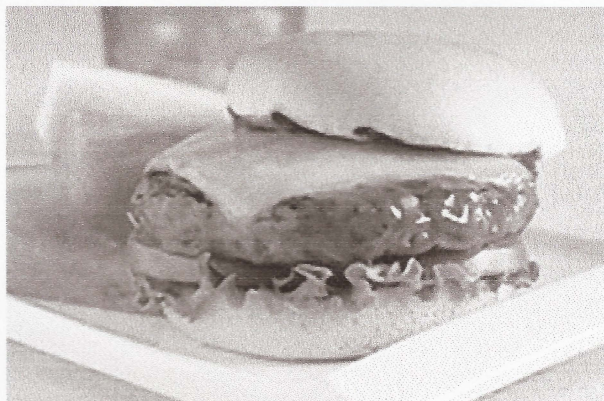
time

prep: total:
10 min   25 min

servings

total:
4 servings, one cheeseburger each

what you need

1	lb.	ground beef
1/4	cup	finely chopped red onions
1	clove	garlic, minced
4		hamburger buns, split
1/2	cup	BULL'S-EYE Smokin' Chipotle Barbecue Sauce, divided
4		KRAFT Big Slice Sharp Cheddar Cheese Slices
4		lettuce leaves
1	medium	tomato, cut into 4 slices

make it

PREHEAT greased grill to medium-high heat. Mix meat, onions and garlic; shape into four patties.

GRILL patties 8 min. Turn patties; brush with 1/4 cup of the barbecue sauce. Grill 4 min. or until patties are cooked through (160°F). Brush cut sides of buns with remaining 1/4 cup barbecue sauce; place, cut-sides down, on grill. Grill 1 to 2 min. or until buns are lightly toasted. Top each patty with 1 cheese slice; grill an additional 1 min. or until cheese begins to melt.

COVER bottom halves of buns with lettuce and tomatoes; top with cheeseburgers and tops of buns.

kraft kitchens tips

SERVING SUGGESTION
Serve with a tossed green salad to round out the meal.

SPECIAL EXTRA
For extra kick, combine 1/4 cup KRAFT Real Mayo Mayonnaise and 2 Tbsp. BULL'S-EYE Smokin' Chipotle Barbecue Sauce. Spoon evenly over cheeseburgers before covering with tops of buns.

KEEPING IT SAFE
Make sure to wash hands and any surfaces well after handling raw meat.

servings

total:
4 servings, one cheeseburger each

nutritional info per serving

per serving

Calories	490	Total fat	24 g	Saturated fat	11 g
Cholesterol	95 mg	Sodium	780 mg	Carbohydrate	37 g
Dietary fiber	2 g	Sugars	16 g	Protein	30 g
Vitamin A	25 %DV	Vitamin C	10 %DV	Calcium	25 %DV

APPENDIX I

AHP ANALYSIS RESULTING INDIVIDUAL MAIN CRITERION
SEGMENTED SCORE

Criteria Pairwise Comparison Matrix

	Advanced	Practicality	Price	Spacious	Intermediate Matrix				Criteria Weights	
Advanced	**1.00**	**0.12**	**0.19**	**1.00**	0.06	0.06	0.07	0.08	**0.07**	
Practicality	**8.20**	**1.00**	**1.20**	**4.40**	0.53	0.46	0.47	0.34	**0.45**	
Price	**5.40**	**0.83**	**1.00**	**6.70**	0.35	0.38	0.39	0.51	**0.41**	
Spacious	**1.00**	**0.23**	**0.15**	**1.00**	0.06	0.10	0.06	0.08	**0.08**	
	15.60	2.18	2.53	13.10	Consistency Index CI / RI =				0.0199	**Acceptable**

Figure 57 AHP analysis main criterion comparison matrix

Alternative Pairwise Comparison Input with respect to: **Advanced**

Pairwise Comparison Matrix

Alternative Weights		Layout A	Layout B	Layout C
0.26	Layout A	1.00	3.00	0.33
0.11	Layout B	0.33	1.00	0.20
0.63	Layout C	3.00	5.00	1.00
0.0334	Acceptable	4.33	9.00	1.53

Consistency Index CI / RI =

3.0	3.0	5.0
Layout A / Layout B	Layout A / Layout C	Layout B / Layout C

Layout A	**Layout C**	**Layout C**
is better than	is better than	is better than
Layout B	**Layout A**	**Layout B**

with respect to :

Advanced

Intermediate Matrix

0.23	0.33	0.22
0.08	0.11	0.13
0.69	0.56	0.65

Figure 58 AHP analysis advanced main criterion individual segment score

Alternative Pairwise Comparison Input with respect to: **Practicality**

Pairwise Comparison Matrix

Alternative Weights		Layout A	Layout B	Layout C
0.63	Layout A	1.00	5.00	3.00
0.11	Layout B	0.20	1.00	0.33
0.26	Layout C	0.33	3.00	1.00
CI / RI = 0.0334	Acceptable	1.53	9.00	4.33

Consistency Index

5.0	3.0	3.0

| Layout A / Layout B | Layout A / Layout C | Layout B / Layout C |

Layout A	Layout A	Layout C
is better than	is better than	is better than
Layout B	Layout C	Layout B

with respect to :

Practicality

Intermediate Matrix

0.65	0.56	0.69
0.13	0.11	0.08
0.22	0.33	0.23

Figure 59 AHP analysis practicality main criterion individual segment score

Alternative Pairwise Comparison Input with respect to: **Price**

Pairwise Comparison Matrix

Alternative Weights		Layout A	Layout B	Layout C
0.60	Layout A	1.00	3.00	3.00
0.20	Layout B	0.33	1.00	1.00
0.20	Layout C	0.33	1.00	1.00
CI / RI = 0.0000	Acceptable	1.67	5.00	5.00

Consistency Index

3.0	3.0	1.0

| Layout A / Layout B | Layout A / Layout C | Layout B / Layout C |

Layout A	Layout A	Layout B
is better than	is better than	is better than
Layout B	Layout C	Layout C

with respect to :

Price

Intermediate Matrix

0.60	0.60	0.60
0.20	0.20	0.20
0.20	0.20	0.20

Figure 60 AHP analysis price main criterion individual segment score

Alternative Pairwise Comparison Input with respect to: **Spacious**

Pairwise Comparison Matrix

Alternative Weights		Layout A	Layout B	Layout C
0.26	Layout A	1.00	3.00	0.33
0.11	Layout B	0.33	1.00	0.20
0.63	Layout C	3.00	5.00	1.00
0.0334	Acceptable	4.33	9.00	1.53

Consistency Index

CI / RI =

3.0	3.0	5.0

Layout A		Layout A		Layout B	
Layout B	▼	Layout C	▼	Layout C	▼
▲		▲		▲	
▼		▼		▼	

Layout A	Layout C	Layout C
is better than	is better than	is better than
Layout B	Layout A	Layout B

with respect to :

Spacious

Intermediate Matrix

0.23	0.33	0.22
0.08	0.11	0.13
0.69	0.56	0.65

Figure 61 AHP analysis spacious main criterion individual segment score

APPENDIX J
VEGETABLE- AND/OR CROP TYPE SPECIFICS

Vegetable and/or Crop	Overview	Optimum pH	Cultivar Recommendation	Soil Preparation	Fertiliser and/or Compost	Sowing or Planting	Transplanting	Harvesting	Further Treatment	Pests	Diseases
Broccoli		6.0 - 7.0	Calabrese, Green Duke, Premium Crop								
Carrots		6.0 - 7.0	Cape Market, Chantenay, Nantes								
Lettuce		5.5 - 7.0	Grand Rapids, London White Cos, and Paris White Cos, All the Year Round and White Boston, Great Lakes				NA				
Onions		5.5 - 7.0	Australian Brown, Caladon Globe, De Wildt, Cape Flat, Hojem, Texas Grano				NA				
Peas		6.0 - 7.5	Black-eyed Susan, Cape Freezer, Greenfeast, Sugar Snap				NA				
Potatoes		5.0 - 6.5	BP 1, Up-To-Date, Van der Plank				NA				
Pumpkin		6.0 - 7.5	Flat Boer, Ironbark, Queensland Blue				NA				
Peppers		5.5 - 7.0	California Wonder, Chilli, Keystone Resistant Giant, Long Red Cayenne								

APPENDIX K

EMPLOYMENT CONTRACT

Employment Contract:

USIZO LOMUSA

FEEDING SCHEME

Entered Into Between:
(herein after referred to as "the employer")

Name &
address of employer: _____

_____

_____

and

(herein after referred to as "the employee")

Name &
address of employee: _____

_____

_____

1. Commencement
This contract will begin on _____ and continue until terminated as set out in clause 4.

2. Place of work _____

3. Job description
Job Title _____

Duties

_____

_____

_____

_____

_____

4. Termination of employment (See Guidelines 1 and 2)
Termination of this contract will be _____ weeks. Notice must be given in writing. In the case where an employee is illiterate notice may be given by that employee verbally.
The parties agree that on termination of the contract of employment, the employer shall furnish the employee with a certificate of service and the UIF card.

5. Wage(See Guidelines 3 and 4)

5.1	The employees wage shall be paid in cash on the last working day of every week/month and shall be:	R_____
5.2	The employee shall be entitled to the following allowances/payment in kind:	R_____
5.2.1	A weekly/monthly transport allowance of	R_____
5.3	The total value of the above remuneration shall be	R_____
	(The total of clauses 5.1 to 5.2.3) (Modify or delete clauses 5.2.1 to 5.2.3 as needed)	

5.4 The employer shall review the employee's salary/wages once a month.

6. Hours of work (See Guidelines 5)
6.1 Normal working hours will be from_____a.m. to_____p.m. on Mondays to Fridays and from _____a.m. to_____p.m. on Saturdays.
6.2 Overtime will only be worked if agreed to between the parties, from time to time.
6.3 The employee will be paid for overtime at the rate of one and a half times his/her total wage as set out in clause 5.3.

7. Meal Intervals (See Guideline 6)
The employee agrees to a lunch break of one hour/30 minutes(delete the one that not applicable).
Lunchtime will be taken from_____ to_____daily.

8. Sunday work (See guideline 7)
Any work on Sundays will be by agreement between the parties from time to time. If the employee works on a Sunday he/she shall be paid double wage for each hour worked as in 5.3.

9. Public Holidays (See Guideline 8)
The employee will be entitled to all official holidays on full pay.
If an employee does not work on a public holiday, he/she shall receive normal payment for that day.
If the employee works on a public holiday he/she shall be paid double.

10. Annual Leave (See Guideline 9).
10.1. The employee is entitled to_____days paid leave after every 12 months of continuous service. Such leave is to be taken at times convenient to the employer and the employer may require the employee to take his/her leave at such times as coincide with that of the employer.

11. Sick leave (See Guidelines 10).
11.1 During every leave cycle of 36 months the employee will be entitled to an amount of paid sick leave equal to the number of days the employee would normally work during a period of six weeks.
11.2 During the first six months of employment the employee will be entitled to one day's paid sick leave for every 26 days worked.
11.3 The employee is to notify the employer as soon as possible in case of his/her absence from work through illness.

12. Maternity leave (See guidelines 11)
(Tick the applicable clauses in the space provided).
12.1 The employee will be entitled to_____days maternity leave without pay; or
12.2 The employee will be entitled to_____days maternity leave
on _____pay.

13. Family responsibility leave (See Guideline 12)
The employee will be entitled to three days family responsibility leave during each leave cycle.

14 Deductions from remuneration (See Guideline 13).
The employer may not deduct any monies from the employee's wage unless the employee has agreed to this in writing on each occasion.

15. Other conditions of employment or benefits

_____

_____

_____

_____

_____

_____

_____

_____

_____

16. General
Any changes to this agreement will only be valid if they are in writing and have been agreed to and signed by both parties.
THUS DONE AND SIGNED AT _____ ON THIS _____ DAY OF
_____20_____

EMPLOYEE:

_____

EMPLOYER:

_____

Witnesses:

_____

_____

GUIDELINES

1. Notice period and termination of employment.
In terms of the Basic Conditions of Employment Act, any party to an employment contract must give to the other written notice of termination as follows;
One week, if employed for four weeks or less;
Two weeks if employed for more than four weeks but less than one year; and
Four weeks if employed for one year or more.

2. Procedure for termination of employment.
Whilst the contract of employment makes provision for termination of employment, it must be understood that the services of an employee may not be terminated unless a valid and fair reason exists and fair procedure is followed. If an employee is dismissed without a valid reason or without a fair procedure, the employee may approach the CCMA for assistance.
Pro-rata leave and severance pay might be payable. In the event of an employee being unable to return to work due to disability, the employer must investigate the nature of the disability and ascertain whether or not it is permanent or temporary. The employer must try to accommodate the employee as far as possible, for example, amending or adapting their duties to suit the disability. However, in the event of it not being possible for the employer to adapt the employee and/or to find alternatives, then such employer may terminate the services of the employee.
The Labour Relations Act, 66 0f 1995, sets out the procedures to be followed at the termination of services in the Code of Good Practice, in Schedule 8.

3. Wage/remuneration/Payment
There is no prescribed minimum rate of remuneration. Additional payments (such as for overtime or work on Sundays or Public Holidays) are calculated from the total remuneration as indicated in clause 5.3 of the contract.

4. Transport allowances, bonuses, increases
These are not regulated by the Basic Conditions of Employment Act and are therefore open to negotiation between the parties.

5. Hours of work
5.1 Normal hours (excluding overtime)
An employee may not be made to:
Work more than 45 hours a week;
Work more than nine hours per day for a five day work week;
Work more than eight hours a day for a six day work week; and

5.2 Overtime
An employee may not work more than three hours of overtime per day or 10 hours per week. Overtime must be paid at 1.5 times the employee's normal wage or an employee may

5.3 Daily and weekly rest periods
5.3.1 A daily rest period of 12 consecutive hours and a weekly rest period of 36 consecutive hours, which must include Sunday, unless otherwise agreed, must be allowed.

6. Meal intervals
An employee is entitled to a one-hour break for a meal after not more than five hours work. Such interval may be reduced to 30 minutes, by agreement between the parties. If required or permitted to work during this period, remuneration must be paid.

7. Sunday work
Work on Sundays is voluntary and an employee can therefore not be forced to work on a Sunday. If the employee works on a Sunday he/she shall be paid double the daily wage. If the employee ordinarily works

on a Sunday he/she shall be paid one and one-half time the wage for every hour worked.

8. Public Holidays

The days mentioned in the Public Holidays Act must be granted but the parties can agree to further public holidays. Work on a public holiday is entirely voluntary and an employee may not be forced to work on such public holiday.

The official public holidays are:

New Years Day, Youth Day, Human Rights Day, National Women's Day, Good Friday, Heritage Day, Family Day, Day of Reconciliation Freedom Day, Christmas Day, Worker's Day, Day of Goodwill.

Any other day declared an official public holiday from time to time should also be granted.

These days can be exchanged for any other day by agreement. If the employee works on a public holiday he/she shall be paid double the normal day's wage.

9. Annual leave

Annual leave may not be less than 21 consecutive days for full-time workers or by agreement, one day for every 17 days worked or one hour for every 17 hours worked. The leave must be granted not later than six months after completion of the period of 12 consecutive months of employment. The leave may not be granted concurrent with any period of sick leave, nor with a period of notice of termination of the contract of employment.

10. Sick leave

During every sick leave cycle of 36 months an employee is entitled to an amount of paid sick leave equal to the number of days the employee would normally work during a period of six weeks.

During the first six months of employment, an employee is entitled to one day's paid sick leave for every 26 days worked. The employer is not required to pay an employee if the employee has been absent from work for more than two consecutive days or on more than two occasions during an eight-week period and, on request by the employer, does not produce a medical certificate stating that the employee was unable to work for the duration of the employee's absence on account of sickness or injury.

11. Maternity leave

The employee is entitled to at least four consecutive months` maternity leave. The employer is not obliged to pay the employee for the period for which she is off work due to her pregnancy. However, the parties may agree that the employee will receive part of her entire salary/wages for the time that she is off due to pregnancy.

12. Family responsibility leave

Employees employed for longer than four months and for at least four days a week are entitled to take three days' paid family responsibility leave during each leave cycle when the employee's child is born, when the employee's child is sick or in the event of the death of the employee's spouse or life partner or parent, adoptive parent, grandparent, child, adopted child, grandchild or sibling.

13. Deduction from the remuneration

The Basic Conditions of Employment Act prohibits an employer from deducting any monies from the employee's wages without his/her written permission.

14. Other issues

There are certain other issues which are not regulated by the Basic Conditions of Employment Act such as probationary periods, right of entry to the employer's premises, afternoons-off, week-ends-off and pension schemes, medical aid schemes, training/school fees, funeral benefits and savings account. However, the aforementioned may be negotiated between the parties and included in the contract of employment.

15. Prohibition of Employment

The Basic Conditions of Employment Act prohibits employment of any person under the age of 15 and it is therefore important for an employer to verify the age of the employee by requesting a copy of the identity document or birth certificate.

16. Other Conditions of Employment

There is no provision, which prevents any other conditions of employment being included in a contract of employment but any provision which sets conditions which are less favorable than those set by the Act, would be invalid.

NB: These guidelines are not meant to be a complete summary of the Basic Conditions of Employment Act and/or legal advice. Should there be any doubt as to rights and/or obligations in terms of the Act or terms of any clause of the suggested Contract of Employment, such queries can be directed to the local office of the Department of Labour, who will gladly assist.

APPENDIX L

BALANCED SCORECARD

Balanced Scorecard

USIZO LOMUSA
FEEDING SCHEME

Perspective	Indicator	Weight	Description	Value
Financial Perspective				
	Was the amount received sufficient.	5		
	Unforeseen circumstances.	3		
	Was a profit made at the end of the month.	2		
Total Performance in group			Financial Perspective	
Customer Perspective				
	Did all the children receive satisfactory food.	6		
	Improvement in the relevant pupils' behaviour.	3		
	Did the scholars complement the final food products.	1		
Total Performance in group			Customer Perspective	
Internal Processes Perspective				
	Did the team work together in harmony	4		
	Unfavourable situations	3		
	Any injuries	3		
Total Performance in group			Internal Processes Perspective	
Education and Growth Perspective				
	Was a new candidate operator in service.	2		
	Did an operator complete the relevant training.	2		
	Were the model specific targets met.	6		
Total Performance in group			Education and Growth Perspective	

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Figure 62 *USIZO LOMUSA* **Feeding Scheme business engineering model balanced scorecard**

APPENDIX M

INVOICING

USIZO LOMUSA

FEEDING SCHEME

PRO FORMA INVOICE

Bill To:

Page:	
Invoice Number:	
Status/Type:	
Invoice Date:	
Customer Number:	
Payment Terms:	
Your Reference:	
Our Reference:	

For billing questions, please call:

Buyers VAT Registration ID:

Sellers VAT Registration ID:

Line	Adj	Identifier	Description	Quantity	UOM	Msg	Unit Amount	Net Amount

TOTAL AMOUNT DUEL: **ZAR**

REMIT TO INFO:

Banking details:
Please forward proof of payment/remittance advice to:

APPENDIX N

FINAL PROJECT REPORT ASSESSMENT SHEET

Final Project Report Evaluation
BPJ 420

Department of Industrial & Systems Engineering

ECSA 1: Problem solving.
ECSA 3: Engineering design (includes evaluation and validation).

Student Name:	
Student Number:	
Examiner:	

Use the performance indicators to grade the student's work from (0..5) for the 6 criteria below

Performance indicators					
Not done	Needs serious attention	Needs attention	Meets required standard	Exceeds required standard	Excellent performance
0	1	2	3	4	5

Provide a motivation (constructive criticism) when a grade of 0, 1 or 2 is given

Crit No	Criteria	Grade (0..5)	Motivation	Weights
1	Is the project properly motivated and has the problem/directive/opportunity/need been identified and formulated? *[Also assessed in BPJ 410]*		The project…	2
2	Does the investigation of the project environment and the literature review assist in understanding the problem context, solution requirements AND the development of the design/solution? *[Also assessed in BPJ 410]*			3
3	Have the appropriate IE mechanisms (methods, skills, tools and techniques) been considered in formulating a design/development approach **and was the development approach applied** in developing a solution? *[BPJ 410 focused on consideration of IE mechanisms and not on application]*			4
4	Have *alternative solutions* been considered and *evaluated* (against criteria, *including technical and financial criteria*) for selecting the *preferred solution*?			4
5	Does the *preferred solution* address and solve the problem / project aim? Was the *solution validated* (against initial requirements/objectives or other appropriate means)?			4
6	Is the document written in a scientific and professional style? *[Also assessed in BPJ 410]*			3
	Total (/100)	**0**	*(The total is calculated automatically, multiplying every grade with its weight)*	20