A Market Strategy Analysis for MATRIX Wheelchairs

Royal Hospital for Neuro-disability

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An Interactive Qualifying Project Report
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Abstract

The Royal Hospital for Neuro-disability's Biomedical Engineering Service (BES) department has set a goal to achieve a financial breakeven point for the 2001-2002 fiscal year. In our project, we analysed the strengths, weaknesses, opportunities and threats of the old MATRIX seating wheelchairs along with the potential market demand for the new MATRIX wheelchairs. We presented to the RHNd a valuable tool that provides them with a promotional and positioning strategy for the commercialization of the new MATRIX special seating wheelchairs.

Executive Summary

The Royal Hospital for Neuro-disability (RHNd) in Putney, London is one of the leading national medical charities in England. Founded in 1854 by Dr. Andrew Reed, the RHNd provides an opportunity for neuro-disabled patients to lead satisfying and independent lives. RHNd is a non-profit organization not funded by the National Health Service (NHS) and standard patient costs are covered by statutory authorities. The RHNd's Biomedical Engineering Service (BES) department has set forth a goal to achieve a financial breakeven point for the 2001-2002 fiscal year. In order to meet this goal a business plan has been created that provides an outline of the operations of the department. A part of this plan includes the development and launch of new products. One product that has the potential to make a significant financial contribution to the BES is the MATRIX special seating technology. The BES Department has a new, improved MATRIX seating technology that it wishes introduce to market. However, before this is done, there must an extensive study into the strengths, weaknesses, opportunities and threats of the old MATRIX seating technology. Our study will help gather accurate marketing information is crucial in decision making to ensure that money is not wasted in fruitless endeavours.

Bringing a new product from the conceptual stage through production process design up to product launch is a difficult and costly procedure. The hospital is a charitable organization and its budget is even tighter than a for-profit medical centre. To ensure a successful marketing campaign for the new MATRIX, vital information about the MATRIX needs to be collected such as:

- Cost analysis for the new product
- Market share for the new product
- Strengths, weaknesses, opportunities and threats of the old MATRIX

This information will be gathered for the old MATRIX from the different stakeholders of the product and will be presented as a complete, comprehensive report. This report will contain recommendations about the best strategy for this innovative new wheelchair seating system so that it can be made available to those who need it the most while simultaneously generating revenue for the Biomedical Engineering Services department at the RHNd.

An Interaction Qualifying Project (IQP) challenges students to identify, investigate and report on a self-selected topic examining how science and technology interacts with societal structure and values (WPI Undergraduate Catalogue, 2001-2002). This IQP is aimed at understanding the needs of the users and influencers of the MATRIX and provide the Royal Hospital with clear methods of implementation for this product. It integrates working with the severely handicapped and examining the social commitments of the Royal Hospital. It involves bringing technology to the marketplace in the form of successful products that satisfy the needs of the handicapped and brighten up their lives. This is an IQP because it gives us the opportunity to better our understanding of the society we live in.

The background literature of our project covers information about the following:

- The National Health Service
- The Health Care Environment

- Products of the Biomedical Engineering Service
- The City of London
- The Royal Hospital for Neuro-disability
- New Product Design and Marketing

Each of these sections had been included in our background study of the project as they had direct relevance with our understanding of the problem statement during our preparation period in Worcester. Through the course of this project, significant changes have taken place in our work environment as a result of which the focus of the project has been altered. We have still included all the preparatory work done by our team as this reflects our transition from the beginning of this project to where we stand now.

The methodology section of a project typically reports what was done during the course of the research project and is a step-by-step explanation of how the data for the research was gathered and how it was analysed. The outline of our methodology is as follows:

- Statement of objective
- Our procedure upon arrival at the Royal Hospital for Neuro-disability
- Interviewing
- Sampling methods and possible sampling errors
- Pre-testing
- We identified the stakeholders of the MATRIX to be users and influencers and discussed the following for each of them:
    - Sampling methods
    - Interviewing technique
    - Pre-testing method

    - Follow-up efforts
- Data collection and Organization
- Content analysis
- Market Share and Costing Information

The objective of our methodology was to gather, organize and analyse data about the strengths, weaknesses, opportunities and threats of the MATRIX from the perspective of decision makers involved in buying and selling the product. In order to aid our understanding of the MATRIX product, the background data in the previous section provided us a strong information base to develop an effective methodology. It was a step-by-step explanation of the process we used to gather data in our research project. It is important to include this section in the report as it explains to the readers how the research was carried out – in other words, what the data consisted of and how data were collected, organized and analysed (Berg, 2001).

In our findings and results, we presented all the data gathered in our interviews and the results from our research. We gathered information about the strengths, weaknesses, opportunities and threats of the MATRIX and this information was presented in the form of a SWOT analysis. . In addition to the information gathered in our interviews, we gathered information about the market share of the MATRIX and used these findings to forecast the growth of special seating wheelchairs issued. Finally, we re-organized the costing information for the new MATRIX and presented it to the BES in a readable format. They will be able to use this information to accurately calculate the price per unit and the different tooling costs that could be incurred.

The value of this project for the Royal Hospital for Neuro-disability is that it makes a connection between the skills and services that the hospital has to offer and the needs of special seating wheelchair users. This connection begins with addressing the needs of special seating wheelchair users who require experienced and skilled personnel along with a highly specialized product that is specifically curtailed to the individual user. Presently, the BES Department is equipped and qualified to fulfill the demands of the users within the hospital. By taking these skills along with a new improved product beyond the doors of the hospital, the BES Department can capture a significant market for the users along with generating revenue for the hospital.

The 3-point improvement module that we have provided for the RHNd provides them with a perspective on a promotional strategy for the commercialization of the MATRIX. We have highlighted the areas that we believe that the hospitals' strength lie in and believe that training, quality control and support and service should be the basis of their promotional package. We have also created a tool to predict the unit volume of MATRIX wheelchairs for the year 2001. Our calculation reflects the broad spectrum of the unit volume of the special seats that could be MATRIX dependant on the percentage of market penetration desired by the RHNd and thus provides them with a positioning strategy for the MATRIX wheelchairs. Thus, with this project we provided the Biomedical Engineering Services department with evidence to justify their accomplishments so far and further direction on how to make the new MATRIX a success.

Acknowledgements

Our thanks go to our sponsor, Dr. Steven Cousins, Biomedical Engineering Services and the Royal Hospital for Neuro-disability for giving us the opportunity as students to carry out this research project in London. We would like to thank all our interviewees for giving us their valuable opinions on the research subject and for participating in our project. We would also like to thank Professor Kasouf for his ongoing support and insight through out this project. Individually, we would like to thank our families and friends for keeping us in high spirits. And lastly, we thank Brad for taking one for the team at every corner needed.

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I. Introduction

The Royal Hospital for Neuro-disability (RHNd) in Putney, London is one of the leading national medical charities in England. Founded in 1854 by Dr. Andrew Reed, the RHNd provides an opportunity for neuro-disabled patients to lead satisfying and independent lives. RHNd is a non-profit organization not funded by the National Health Service (NHS) and standard patient costs are covered by statutory authorities. However, the extra services that make a real difference to the lives of the people are raised by charity. Each week the hospital needs to raise £25,000 to purchase essential medical equipment, develop innovative therapy treatments and pioneer research programs. For many patients, the RHNd is their last hope and for some, it has become a home. Thus, the need for an effective business plan with several income generation possibilities is important in order to brighten the lives of the severely disabled.

The RHNd's Biomedical Engineering Service (BES) department has set forth a goal to achieve a financial breakeven point for the 2001-2002 fiscal year. In order to meet this goal a business plan has been created that provides an outline of the operations of the department. A part of this plan includes the development and launch of new products. One product that has the potential to make a significant financial contribution to the BES is the MATRIX special seating technology. The BES Department has a new, improved MATRIX seating technology that it wishes introduce to market. However, before this is done, there must an extensive study into the strengths, weaknesses, opportunities and threats of the old MATRIX seating technology. This study will help gather accurate marketing information is crucial in decision making to ensure that money

is not wasted in fruitless endeavours. In the forecasted budget for 2000-2001 new products account for well over half of new income generation. The goal of the department is to achieve a breakeven point and thus it is extremely important that this new source of revenue be correctly executed in order to fulfil the goal.

Bringing a new product from the conceptual stage through production process design up to product launch is a difficult and costly procedure. The hospital is a charitable organization and its budget is even tighter than a for-profit medical centre. To ensure a successful marketing campaign for the new MATRIX, vital information about the MATRIX needs to be collected such as:

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This information will be gathered for the old MATRIX from the different stakeholders of the product and will be presented as a complete, comprehensive report. This report will contain recommendations about the best strategy for this innovative new wheelchair seating system so that it can be made available to those who need it the most while simultaneously generating revenue for the Biomedical Engineering Services department at the RHNd.

This technology is not produced in a vacuum and it is known that other firms have an interest in producing products that will directly compete with the MATRIX technology. Our project must take in special consideration of that sensitive area. Extra care will have to be given when researching competing products since this area could be highly sensitive. We feel that we can gather sufficient data for within the RHNd itself

and from secondary sources to make valuable recommendations without jeopardizing the hospitals intellectual property. Taking into consideration all the aspects mentioned above, this project is worthy of being an Interactive Qualifying Project (IQP).

An Interaction Qualifying Project (IQP) challenges students to identify, investigate and report on a self-selected topic examining how science and technology interacts with societal structure and values (WPI Undergraduate Catalogue, 2001-2002). At the Royal Hospital for Neuro-disability in London, there is continual need to create and evaluate new products for the handicapped in order to make their lives more comfortable. The new MATRIX special seating technology is an improved product that is currently in the developmental stages and it is vital that there exists an interaction between the technology being created and the people it is being created for. This IQP is aimed at understanding the needs of the users and influencers of the MATRIX and provide the Royal Hospital with clear methods of implementation for this product. It integrates working with the severely handicapped and examining the social commitments of the Royal Hospital. It involves bringing technology to the marketplace in the form of successful products that satisfy the needs of the handicapped and brighten up their lives. This is an IQP because it gives us the opportunity to better our understanding of the society we live in.

To reiterate, this project sets out to gather information about the MATRIX in respect to costing, market share data and the strengths, weaknesses, opportunities and threats of the product. We will assess the strengths, weaknesses, opportunities and threats of the product from the perspective of users and influencers. In order to aid our understanding of the working environment, the literature review supports the problem

statements as it explores topics that are directly related to our project such as, the working of the NHS, understanding the health care environment to understanding the MATRIX and other wheelchair seating devices and looking at the underlying concepts behind new product development. Our methodology outlines the methods we implemented to gather this data from users and influencers and includes information about how we chose our sample population and how the interviews were conducted. We then present our results gathered from the interviews and finally, provide an analysis of all the data gathered from this research project and our recommendations on the marketing strategies for the MATRIX special seating technology.

II. Literature Review

The background literature of our project covers information about the following:

- The National Health Service
- The Health Care Environment
- Products of the Biomedical Engineering Service
- The City of London
- The Royal Hospital for Neuro-disability
- New Product Design and Marketing

Each of these sections had been included in our background study of the project as they had direct relevance with our understanding of the problem statement during our preparation period in Worcester. Through the course of this project, significant changes have taken place in our work environment as a result of which the focus of the project has been altered. We have still included all the preparatory work done by our team as this reflects our transition from the beginning of this project to where we stand now.

2.1 The National Health Service

The National Health Service (NHS) was set up in 1948 to provide healthcare for all English citizens, based on need and not whether they are able to pay or not. It consists of a wide range of health professionals, support workers and organizations.

2.1.1 What is the NHS?

The NHS aims to bring about the highest level of physical and mental health for all citizens, within the resources available, by promoting health and preventing ill-health, diagnosing and treating injury and disease and finally caring for those with a long-term illness and disability, who require the services of the NHS (The National Health Service Online, 2001). In a typical week, 1.4 million people receive help in their home from the NHS, pharmacists dispense approximately 8.5 million items on NHS prescriptions and NHS ambulances will make over 50,000 emergency journeys in England. (The National Health Service Online, 2001). The NHS is funded by the taxpayer and is managed by the Department of Health in England. The department establishes overall health policies in the country and is responsible for putting the policy into action. The Department of Health sets targets for the NHS and monitors its performance constantly.

2.1.2 The New NHS Plan

The new NHS plan was put into action in July 2000 and is a radical action plan for the next ten years to increase the funding over five years by 6.3 per cent and to bring all citizens under the health service. The NHS plan promises its citizens that it will provide more power and information for patients, more hospitals and beds, much shorter waiting times for hospital and doctor appointments, improved care for the elderly, tougher standards for NHS organizations and better rewards for those organizations that excel (The National Health Service Online, 2001). The plan emerged as a result of the NHS failing to deliver over the last few years as it was under funded. This was primarily due to a 1940's operating plan in the 21st century. These systematic problems have been

purged with the new NHS plan which is designed to provide a health service cantered about the patient. The vision of the new NHS plan is to provide the people of Britain with a health service fit for the 21st century (The NHS Plan Online, 2001).

The background research on the reformed NHS plan is of critical importance to the Biomedical Engineering department as it needs respond to the key themes contained in the plan pertaining to the Working in Partnership and Clinical Governance. The Biomedical Engineering department needs to develop closer links and improve working relationships with individual patient's district wheelchair services and local providers of specialist seating services considered to be potential revenue generation services (The Biomedical Engineering Service Business Plan, 2001-2002).

2.1.3 History of the National Health Service

The National Health Service was established on July 5, 1948. For the first time, hospital services, family practitioner services and community-base services were brought under the control of a single organization. Within three years of its creation, the NHS, which had been initially perceived as free of charges, was forced to introduce modest fees to cover its expenses. The early days of the organization were tense as the senior management of the NHS and the government had to work together to create a successful health plan for the citizens of Britain. Today, these tensions have been overcome and the NHS now has a workforce of one million people and a budget of £42 billion per year and is equipped with all the state-of-the-art equipment and technology.

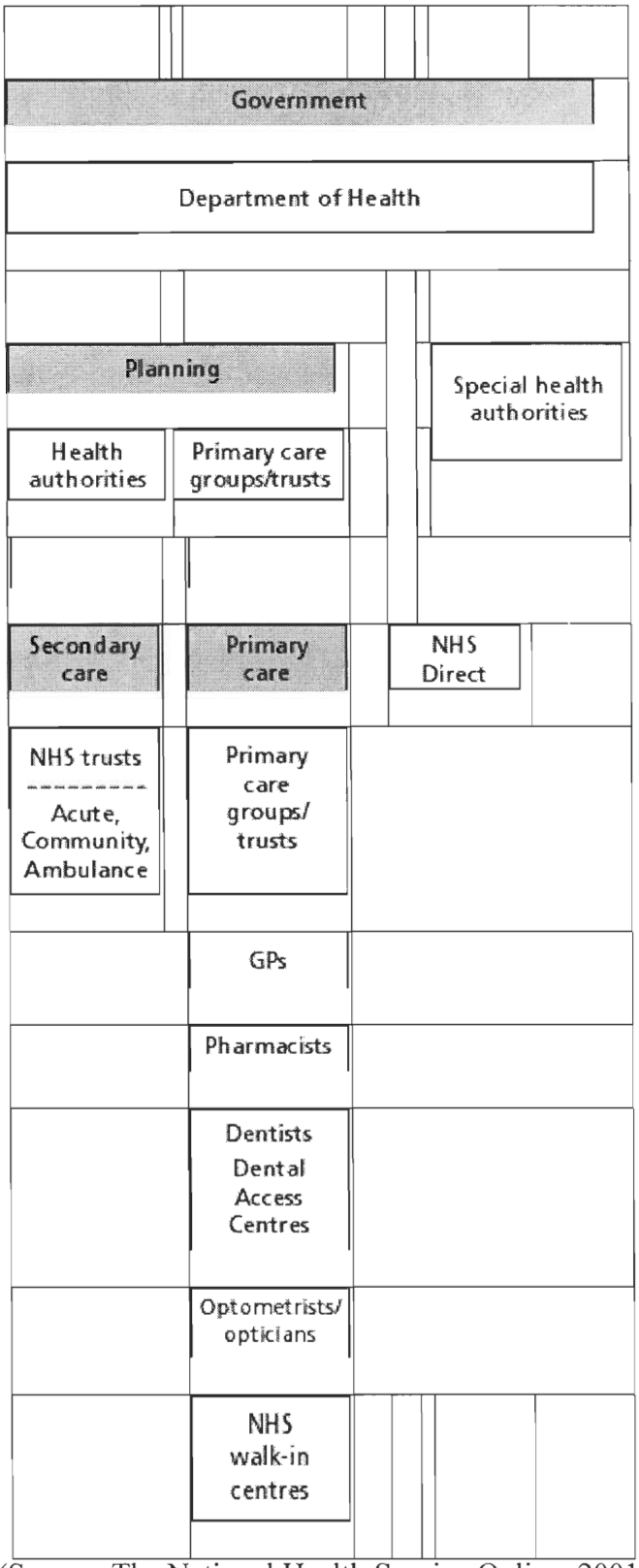
The election of a new Government in May 1997 brought a new approach to the NHS. The British Government set out to eliminate the negative aspects of the previous

plan and build a successful health care service by expanding on all the positive aspects of the NHS. A new white paper issued by the Department of Health, put forward the NHS as "Modern" and "Dependable" and set out to overcome obstacles within the internal market and move toward a more collaborative approach. The white paper described this approach as "a new model for a new century", based on six key principles:

1. To renew the NHS as a genuinely national service offering fair access to consistently high quality, prompt and accessible services right across the country;
2. Second, to make the delivery of healthcare against these new national standards a matter of local responsibility, with local doctors and nurses in the driving seat in shaping services;
3. Third, to get the NHS to work in partnership, breaking down organizational barriers and forging stronger links with the community;
4. Fourth, to drive efficiency through a more rigorous approach to performance, cutting bureaucracy to maximize every pound spent in the NHS for the care of patients;
5. Fifth, to shift the focus onto quality of care so that excellence would be guaranteed to all patients, with quality the driving force for decision-making at every level of the service;
6. And sixth, to rebuild public confidence in the NHS as a public service, accountable to patients, open to the public and shaped by their views.

With these six key principles, the NHS has set foot into a new era (The National Health Service Online, 2001).

2.1.4 The functioning of the NHS



(Source: The National Health Service Online, 2001)

The diagram on the previous page depicts the working perspective of the National Health Service showing the many tiers of the organization from the government to the pharmacists to the NHS walk-in centres.

The government represented by the Department of Health is responsible for delivering a fast, fair and high quality of health care and social service to the people of England. The Department of Health plays an important role in delivering the key information required for organizations to meet the Government's policies and meet the national standards for patient care. Health authorities take on the role of identifying the health needs of the local people and make arrangements for the necessary services to be provided by the NHS and its agencies. Special health authorities are a health authority that provides health services to the whole population of England and not just to a local community.

The NHS Direct opened in March 1998 and offers fast and free 24-hour advice about personal health care. NHS Direct nurses are trained to provide callers with the advice and reassurance they need to care for themselves at home and also help to direct them quickly to the right service required at the right time. NHS trusts are found in most large towns and cities and usually offer a general range of services to meet most people's needs. Some trust are also attached to universities and offer training for health care professionals. NHS walk-in centres offer fast access to health advice and treatment and are available to anybody. This centre provides seven days a week service by an experienced NHS nurse. They also treat patients for minor injuries and illnesses and

provide information on local pharmacy services. The first NHS walk-in centres opened in January 2000 and there are now 40 such centres functioning.

The first port of call for many people when they develop a health problem is their primary health care provider or the general practitioner (GP). GP's serve on the frontline of the NHS services and work along with nurses and other help aids. Since 1999, GP's in Britain have been able to join together to form 'primary care groups' along with other health professionals. They are given the funding to work together to plan and commission health services for their local communities and this way decisions about a local service are made at a local level. Secondary care is usually specialized treatment provided by a hospital.

The Royal Hospital for Neuro-disability is a charity hospital in London and the expenses for most of the patients are covered by the National Health Services. We incorporated information about the National Health Service in our background literature in order to better understand how patients were funded for and to assess the extent to which the NHS will fund new products. The NHS played the role of an influencer in our project, as their decisions had direct influence on the marketing methods of the MATRIX. We also integrated the structure of the NHS in our research as it provided us with a working model of the NHS and aided us in understanding who the policy makers are and how we were able to contact them while in London.

2.2 The Health Care Environment

The health care industry provides costly, varied and sophisticated human and capital resources to maintain and improve the lives of the people they serve (Nelson, 1982). Health organizations have to plan, co-ordinate and control all these resources while keeping their costs low and providing quality care to patients. Thus, it is essential for hospitals to be able to explain their cost structure to the public and the concerned board of directors and insurance companies (Barocci, 1981).

2.2.1 Non-profit Hospitals

A hospital that operates under a corporate structure is known as a non-profit hospital (Barocci, 1981). The core of a non-profit hospital consists of physicians who make the health service purchase decisions for their patients, trustees or a board of directors who guide the hospital in making major business decisions and charting future plans, the government that purchases the services of the hospital at wholesale prices and finally a large organization with state branch operations that serves as a centre for data collection on the hospital employees, costs and problems.

The boards of trustees for a non-profit hospital play an important role in its administration. They make major decisions and have a hand in all the operations of the hospital excluding medical affairs. Medical supervisors report to the boards of trustees about any medical affairs and often a joint policy committee, made up of members of the medical staff and board of trustees is appointed to carry out negotiations. Traditionally a superintendent carried out the administration of a non-profit hospital by responding to the needs of the medical staff. However, in the recent years this task has been entrusted in the

hands of a professional manager who controls a group of staff accountants, financial experts, planners and technicians.

The hospital workforce consists of skilled, unskilled and semi-skilled workers. Physicians influence the workforce of the hospital since they determine the wages, advancement opportunities and utilization. The physicians control directly or indirectly the structure of service delivery, the pricing of care, the accreditations of hospitals and medical schools, the labour and capital mix of hospital and the public laws related to licensing. Thus physicians control a great deal of the operations in a non-profit hospital.

A non-profit hospital often has outside interest groups who have entered the picture on all levels. These interest groups can range from governments to institutions like the American Medical Association to the Blue Cross and Blue Shield Organizations. These institutions take on the role to set and maintain medical-care standards and to organize the training and qualification of the physicians. The variety of the outside forces acting on the non-profit hospital have led to an increased competition between hospitals based on power, prestige, size of revenues and the ability to generate non-regulated income (Barocci, 1981).

Thus, at a non-profit hospital there are a number of forces acting on each other from the non-profit regulated income to the workforce within the industry. It is vital to the health and welfare of those people that need its services and to serving the entire community.

2.2.2 Hospital Operating Statement

The Hospital's operating statement is a crucial element in the creation of a business plan, because the plan must adhere to specific guidelines set up by the hospital to best suit its needs. The Royal hospital of Neuro-Disability (RHNd) is a unique hospital with very specific guidelines for how it must operate. These factors were very important when looking at ways of improving their operations to reach a breakeven point in their financial situations. The basic operating statement we are going by is to maintain the service quality of the hospital, to increase the external referral base, to increase the internal contract base, to reduce service costs and to develop new products (Preliminary Business Plan for the RHNd, 2000-2001).

The service given at the RHNd is a very important aspect of our project, because they are known for giving a particularly high standard of care for each of their patients. The hospital obviously does not want to sacrifice any of their service aspects in the name of making budget cuts. The main reason for this is because a large basis of their current income depends on external referrals. These referrals occur because people over time have learned that the RHNd is a quality establishment with a longstanding tradition of excellence towards its patients (Preliminary Business Plan for the RHNd, 2000-2001). The longstanding traditions of the RHNd have lead to a loyal following of external referrals.

The external referral base for the RHNd is an important aspect of their overall operating statement for the business plan. This is important because the projected income of external referrals is very high. Based on projected numbers for the upcoming year the hospital is planning on making approximately £100,000 from both external and internal

contracts based off referrals (Preliminary Business Plan for the RHNd, 2000-2001). This figure would represent almost 1/3 of their total income for the year, which is very significant. Also this figure shows the potential money making possibilities that could be exploited from this particular area of the hospital's operational plan. By continuing to expand our external referrals the hospital will continue to increase its revenue and this type of growth has an exponential rate. Along with its external referral base the hospital would also like to increase its internal contract base drastically (Preliminary Business Plan for the RHNd, 2000-2001).

The RHNd plans on increasing its funding through an aggressive plan of gaining more contracts to help meet their income needs. These contracts will be developed through their various ventures into design and manufacture, such as the MATRIX seating system and other such projects. This is congruent with the beliefs of the hospital to continue excellent service to its patients and to bring state of the art technology to all of its patients. Since the hospital is non-profit organization it is imperative that they can meet all their expenses, so it is necessary for the BES to be able to have a strong source of income aside from their regular patients. This alternate source of income will come from contracts that will be created within the next year with various firms in the UK (Preliminary Business Plan for the RHNd, 2000-2001). Since the current income of the BES falls significantly short of their overall expenses it is necessary for some alternate form of money to be acquired by the BES. This money is currently coming from the charitable arm of the RHNd, however each year the RHNd is able to give less and less to the BES forcing them to become more self-sufficient. This self-sufficiency is actually a blessing in disguise, because by switching to contract based income generators the BES

will have a steady long-term form of income. This steady long-term income will help support the BES, and allow the BES to expand its other areas of development, such as reduced costs for its current services.

Reducing service costs is a goal of the BES, because only by keeping their overall prices down can they keep their current patient base and increase this patient base (Preliminary Business Plan for the RHNd, 2000-2001). The current services of the BES are very comprehensive and the BES wishes to keep their services the same way, however there are certain areas which may lend themselves to cost cutting techniques. Certain aspects of production are currently being done by outside contractors, and these specific parts could for a small start up fee be produced on-sight at a greatly reduced price to the consumer (Preliminary Business Plan for the RHNd, 2000-2001). By reducing these off site costs the BES hopes to eliminate approximately £7,000 from their overall budget (Preliminary Business Plan for the RHNd, 2000-2001). By moving some of the various production to the hospital itself not only does it reduce costs, it also creates an infrastructure for future production possibilities. These production possibilities also lend itself to the creation of new products, because there is also the possibility that these new products could be manufactured on-sight continuing to keep costs at a low.

The creation of new products is a commitment BES has made from its beginning. The research and development aspects of the BES are very active and there are currently several new products waiting to be put into service. The most significant of these new products is the MATRIX seating system which has been developed for several years and is expected to help the BES win some wheelchair seating contracts (Preliminary Business Plan for the RHNd, 2000-2001). Along with the MATRIX seating system there are

several other projects the BES are working on that they believe will help contribute to their general income in the following year. If all the products currently under development go into production and get contracts the financial situation of the BES will be very healthy. If all the projected contracts for the BES' various products get picked up the BES will have a surplus of approximately £10,000 with which to possibly expand their research and development department (Preliminary Business Plan for the RHNd, 2000-2001).

2.2.3 Personnel Structure

Conventionally, the personnel structure at a non-profit hospital consists of primarily four groups, the physicians and dentists, registered nurses, licensed practical nurses and other hospital staff. In the recent years, the health care team has evolved from these four major groups to over five hundred occupational groups.

The hospital personnel is required to be trained based on the 1966 Allied Health Professions Personnel (AHPP) Act which emphasized non-baccalaureate degree occupational training for health care personnel (Barocci, 1981). The training carried out for health care personnel is either federally funded or carried out by hospital itself. In the recent years, there has been rapid growth in the hospital personnel and due to the specialty of skills needed; the training is taken on by the hospital. Certain departments of the hospital have the training and education partially paid by the government and insurance companies such as nursing care. However, majority of the training for the non-profit hospital personnel is carried out in-house as it is an efficient, cost effective method of supplying the hospital with the highly trained personnel it needs.

Human resource planning is integral for any hospital and in the United States, some states have made it mandatory to have one-year and five-year strategic plans (Barocci, 1981). Due to the large number of personnel the hospital employs, it is essential for them to integrate human resource planning into their structure. Hospital personnel planning could result in more efficient flow of work within the hospital firm and reduce occupational competition. Another benefit of hospital planning is that it could eliminate the shortage of trained personnel and in turn lower labour costs. However, this type of planning is often hindered due to organizational problems and the need for strict licensing for skilled hospital workers.

Thus, the personnel structure of the hospital industry now comprises of over five hundred workgroups and the rise in hospital employment is a result of the method of health care delivery.

2.2.4 Hospital Regulations

The rationale for hospital regulation stems from a basic belief that hospitals are localized natural monopolies and, as such, regulatory control is needed at the federal and state levels to insure that the right amount of high-quality medical care is delivered at a reasonable price (Barocci, 1981). All hospitals require regulatory procedures in order to ensure that they are providing quality care and costs that can be afforded by most people. Hospitals are vital to the health of the public and a regulatory system ensures that they are not exploiting the community.

Hospitals face three different types of regulations that have been specifically designed for the health care industry. The regulations are entry controls, price controls

and quality controls. In addition to these three major regulations hospitals also face a number of other regulations that impact their operations and training. Entry control regulations are written to control expenditures that are written into the cost structure of hospitals. In the US institutions like Blue Cross require that hospitals provide them with a justification for capital expenditures and may refuse reimbursement if the party proceeds without approval. Price control regulations require hospitals to be cost conscious about their expenditures as non-profit hospitals are reimbursed for all their expenditures. Rates are often set by either the government or agencies like Blue Cross or Medicare that pay for all the hospital's expenditures. Finally, quality control regulations place a check on the quality of medical services offered by the hospitals and physicians. Quality control measures implemented by an external organization have eliminated problems of over-utilization and unnecessary hospitalisation.

This section in our background literature related to the health care environment had direct significance to our project, as we were operating in a health care environment for the seven-week period in London. We covered in our background literature the operation of non-profit hospitals, a look at the financing of a hospital and understanding the personal structure at a hospital. These subjects provided us with critical data required to understand the environment we were operating in and to understand how decisions were made in a hospital. In order to gather data from these people in a short period of time and it is vital that we understood the functioning of the health care industry.

2.3 Products of the Biomedical Engineering Services

2.3.1 The MATRIX Seating System

Based on the three types of users wheelchair designs are selected and fitted to match each individual subject. One system that has been developed to accommodate this is the MATRIX seating system. The MATRIX is a system of interlocking joints that can be shaped to fit the contours of someone's body. This is useful, because in many cases of wheelchair seating the user is going to be in the chair for extended periods of time, thus requiring an excellent fit in order to maintain proper posture and muscle tone. By utilizing the MATRIX seating system the material is form fitted to the user and then locked into place using washers and bolts to secure the joints. From that stage the MATRIX form is then bolted to a wheelchair frame. This overall frame is chosen based on the user's need, dependent mobility, independent mobility, or independent power mobility. The MATRIX system can be mated to almost any type of frame. From this stage the MATRIX is covered with the actual padding the user will be sitting on. By using this technique the user gets a custom moulded shape seat and the padding will keep its shape, because it is supported by the MATRIX infrastructure. The MATRIX is also useful because it can be formed into many different shapes and rolls to accommodate most any position that a user might require.

2.3.2 Wheelchair Seating Devices

The different systems that are incorporated in the designing of wheelchairs are completely dependent on the mobility of the users. Because of the different mobility

characteristics of wheelchair users there are several different types of wheelchairs to accommodate. The different types of wheelchairs available are based on the condition of the user, which is gauged into three categories. The categories are dependent mobility, independent mobility, and independent power mobility (Warren, 1990).

These different categories are very different and are utilized to fit the proper wheelchair to each individual. The first category is dependent mobility where the user cannot use the wheelchair without assistance. This means that the user will always have someone propelling him/her around when necessary. This also means that a wheelchair designed for this purpose will have more use in mobility designed in for the person aiding in the movement of the user. Instead of being primarily designed for the user this type of wheelchair is made with a view of influencers in mind (Cook and Hussey, 1995). Another type of specification is the ability for independent manual mobility.

This independent mobility is almost the opposite of dependent mobility, because it means that the wheelchair user can actual move independent of help from anyone else. This drastically changes the type of wheelchair used, because it creates a need for the person sitting in the chair to have the maximum amount of mobility allowed by the chair. This also changes the different and possible types of support that the user might need (Cook and Hussey, 1995). With a user that is independently mobile there tends to be a lesser need for complete upper body support, because the user still has almost full mobility in the upper torso. This also means that the wheelchairs might need to be of lighter weights to accommodate the possibly active lifestyle of an independent mobility user (Cook and Hussey, 1995). The final type of wheelchair user is the dependent mobile

user, which is similar to the independent mobile user, but lacking the upper body strength or ability to independently move a wheelchair.

The independent power mobility user requires the service of a wheelchair that has a motorized movement system. This drastically changes both the design of the wheelchair and the specifications for the user (Ragnarsson, 1990). Since the user cannot independently propel the wheelchair, a motorized system needs to be incorporated into the design to allow the user mobility. Since the user cannot independently move the wheelchair it is most often the case that hands and other extremities might not be useful to actually steer these powered wheelchairs, so there are multiple choices by which to steer and operate the wheelchair (Ragnarsson, 1990). The people using powered wheelchairs are often the most neurologically impaired users, having very little control of their bodies, thus requiring the need for powered wheelchairs (Ragnarsson, 1990).

This aspect of the background literature provided us with a strong understanding of the MATRIX system and its performance compared with other wheelchair seating devices currently in the market. The MATRIX is a system of interlocking joints that can be shaped to fit the contours of someone's body and since we were involved in assessing the opinions of users and influencers of this product, it was important that our group be knowledgeable about the product as well. We included a study about other wheelchair products as they provided us with a means for comparing all aspects of the MATRIX with other similar products. This information helped us make recommendations on marketing strategies that should be employed by the hospital.

2.4 The City of London

London is the biggest city in Western Europe and is situated in the heart of the most populous region. Over 7 million people now live in London and over 25 million chose to visit London in 2000 (London.gov.uk, 2001).

2.4.1 City of London

The city of London has 2000 years of history and has over nineteen thousand buildings that are listed to be of architectural or historic interest. London is Britain's capital city and is one of the leading cities of the world. Since 1855, London has had five different types of metropolitan governments and it now has a directly elected executive mayor for the first time. London is composed of a culturally diverse population and have an extremely diverse neighbourhood. There is over 13,000 hectares if agricultural land within the Greater London boundary and compared to all the major cities of the world, it is still regarded as a safe place to live in.

2.4.2 London Government

The Mayor, London Assembly and the Greater London Authority comprise a new and unique form of strategic citywide government for London. The Mayor is responsible for preparing strategies to deal with London-wide issues and also co-coordinating an action plan on London-wide basis with all the organization that have a role to play in the functioning of the city. There are 32 boroughs and cities within London and along with

the Corporation of London and the Greater London Authority they form the Association of the London government formed in 2000.

2.4.3 Charity Hospitals of London

There are 48 NHS Trusts in London and the NHS in London alone employs 125,000 staff members. There are 32,000 hospital beds available in London on an average day and approximately 7.8 million outpatients were treated in the hospitals during the year 1997-8 (London.gov.uk, 2001). There are 4,000 general practitioners practicing in London and over 3,000 dentists.

We added this subdivision to our literature review, as it was crucial for us to have some background information about the City of London. Since, we were in the City of London for a seven-week period, the information learned from this section helped us orient ourselves to the city. We also included information about other charity hospitals in London, as it aided us in contacting policymakers at other non-profit hospitals and doctors and therapists at rehabilitation centres in London.

2.5 The Royal Hospital for Neuro-disability

The Royal Hospital for Neuro-disability specializes in treating the most serious of the unfortunate victims of fate. Based in Putney, South London experienced and expert staff ensures that each person is given the best available care. With hard work and patience, the Neuro-disabled are given the chance to lead more satisfying and

independent lives. There are many different kinds of Neuro-disabilities and each requiring a specialized type of treatment. An associated charity, the Neuro-disability Research Trust, is dedicated to raising funds for the support of the Hospital's pioneering research program. The education and training of all staff members to the highest possible levels is considered a matter of priority. As a result, the Hospital has justly earned itself a worldwide reputation in the specialist treatment of Neuro-disabilities. The Royal Hospital believes that the sharing of information can make life better for the Neuro-disabled around the world. Specialist conferences and open days are held throughout the year. Both clinical and non-clinical groups attend these events to share our experience and expertise. By working closely with special interest groups, service providers and end users, the Hospital aims to raise public awareness of disability issues and improve professional skills and knowledge. Equally vital to the Royal Hospital's work is the support of many outside organizations, including career groups (The Royal Hospital for Neuro-disability Online, 2000).

2.5.1 History

The Royal Hospital for Neuro-disability was established in July 1854 at a meeting held at the Mansion House, chaired by the Lord Mayor of London. The founder, Andrew Reed, had a fine record as a practical philanthropist, and responded to a plea from the author Charles Dickens to:

"... give permanent relief to such persons as are hopelessly disqualified for the duties of life," but, "not to interfere with the endeavours of existing charities, but to take

action precisely where their action ceased." (The Royal Hospital for Neuro-disability Online, 2000).

The Royal Hospital was originally called the 'Hospital for Incurables' and was based in a converted workhouse in Carshalton, Surrey. In 1857, a more spacious house was leased in Putney, and finally in 1865, patients were moved to the Hospital's present site on West Hill, Putney. In 1903, the organization received the Royal Charter. The building on West Hill in Putney was originally called Melrose Lodge and was bought with 24 acres of land. Until the 1960s, a working farm was part of Royal Hospital life. Although much of this land has now been developed, the Royal Hospital retains spacious landscaped gardens for the use of patients, relatives, and staff. In 1988, the Hospital changed its name to the 'Royal Hospital and Home, Putney'. Because this name did not make it obvious what work was carried out there, in 1995 the name was changed to the 'Royal Hospital for Neuro-disability' (The Royal Hospital for Neuro-disability Online, 2000).

2.5.2 Mission Statement

The Royal Hospital for Neuro-disability, as a national medical charity, is a non-profit organization. Through the provision of specialist services and research, it seeks to meet the needs of people with complex neurological disabilities resulting from damage to the brain and nervous system. (The Royal Hospital for Neuro-disability Online, 2000). The Royal Hospital's philosophy is that all disabled people should have the opportunity to enjoy the best possible quality of life. It works with individuals, organizations and career

groups to improve professional knowledge and skills and to raise public awareness of disability issues.

The Royal Hospital's provision of specialist clinical services enables profoundly disabled people to maximize their quality of life within the limitations of their disability. Research and development projects are undertaken to advance technological methods. These, combined with social and recreational programs, create a greater independence from care for the profoundly disabled. By sharing its experience and knowledge with institutions, healthcare professionals and other organizations, the Royal Hospital can help the Neuro-disabled all over the world (The Royal Hospital for Neuro-disability Online, 2000).

Our goal is to analyse the MATRIX from the perspectives of users and influencers and make recommendation on its marketing strategies. Since we were operating at the RHNd and we incorporated this section in our literature review as we were acquainted with what the hospital does, the mission statement of the hospital and a brief history about the hospital. Upon our arrival in London, this background research proved to be beneficial.

2.6 New Product Design and Marketing

The area of product design and marketing is a key factor in the creation of any new product because there are certain steps that must be taken from the time a concept is thought of to the time it is produced and marketed. Along with understanding new product development, it is also vital to understand this concept from the perspective of

non-profit organizations, as we are dealing with the RHNd that is a non-profit organization. It is also important to understand what buying centres were as we evaluated the strengths and the weakness of this product from the standpoint of users and influencers of the MATRIX.

2.6.1 New Product Development

Product design and marketing take place all the time and there are set patterns to follow, which produce the most reliable and best products. These best products would be defined as products that sell very well in their given markets and are profitable to the producers, because there is clear organization behind the product, and the product is produced at minimal cost, and maximum efficiency. The overall steps for the producing and marketing of a new product are the project definition, organization and staffing, management and leadership, problem solving, and senior management and control (Clark and Wheelwright, 1993).

The project definition is the overall basis for the project itself, because without the broad definition there is no idea of the project in the first place. This is also the step in the organizational process where the scope of the project is fully mapped. Things such as the general idea, possible release dates, and commercialisation aspects are all encompassed in this first step in the process (Clark and Wheelwright, 1993). The most important portion of this step in the design process is the setting of specific goals for the project to achieve. Firms should avoid too great a focus on new product development and should focus on the overall product, and its ability to satisfy the needs of the

consumers (Wind and Mahajan, 1988). As with all the steps in the design process, each one leads progressively to the next until the final product release.

One of the most important steps in the design process is the staffing and organizing of the entire project. This is a crucial step, because the most qualified people are going to be needed, so this step can be a deciding factor on the possible outcomes of the project (Clark and Wheelwright, 1993). The organizing of the project can mean the completion of all the goals, or it can account for delays in bringing the product to commercial readiness. There are two key considerations in organizational structure, which are the extensive formalization, the existence of specific rules and procedures, and centralization, which is the level at which decision-making, is carried out (Calantone, Di Benedetto and Haggblom, 1995). The organization step is vital because if the product is not designed, or is merely an idea, it is possible that without the correct people working on solving the problem then a solution may never be found, and useful capital is wasted. When the organizational procedure is effective there is a greater likelihood of new product innovations of coming to fruition, and a key factor that facilitates this innovation is organizational flexibility (Calantone, Di Benedetto and Haggblom, 1995). Along with the staff and organizational aspects of the project comes the project management.

The management is another integral part of the design process, because they keep the engineers motivated and on task for the maximum benefits in the desired area. The managers are in charge of organizing the schedules for meeting goals and also for organizing individual teams and team leaders (Clark and Wheelwright, 1993). These team leaders and goals keep the project running smoothly and hopefully on schedule, because the longer a product is in the development stages the more time a competitor has

to make a rival product, and more money is spent without any returns for the investment. There is a need to develop an incentives system that is conducive to risk taking and to educate managers at all levels to accept this high level of risk associated with innovative new products (Wind and Mahajan, 1988). Once these basic infrastructure steps are taken the project can move on to the later stages of development.

These later aspects of the design process include the building of a prototype, and the testing and troubleshooting of the product. This stage of development is primarily based not on the product but on the managers and team leaders because it is up to them to keep the pace of the project moving with the schedule (Clark and Wheelwright, 1993). Since the product is already prototyped and for the most part all major problems with the design have been overcome and it is only a matter of putting enough effort and testing into the product to get the desired outcome. Poor project selection and ineffective portfolio management can be disastrous for the product design process (Cooper, 2000). Based off this platform of work, the senior managers then evaluate the product for the next stage of development.

The senior managers have no real direct contact with the actual workings of the project, however their interaction with the product managers is very important because it provides both motivation and incentives to solve any problems (Clark and Wheelwright, 1993). Since the senior management have more responsibilities to deal with it is important that they have total knowledge on the subject that they will be reviewing. In the final stages of development it will be the senior management that has final say in most decisions so their input on the situation must be evaluated before the product can move to the commercial aspect of its cycle.

2.6.2 New Product Innovation

New product innovation is the act of taking an existing product and changing it in a manner that is beneficial to users. This process can take place in several different ways including through product testing research and empathic design. Recent studies have revealed that the art of product innovation has not improved at all and the needs of the customer are still being overlooked, and many products enter the development phase lacking clear definition (Cooper, 1999).

There are certain factors that would lead to the success of new product innovations. One of them is an assessment of the specific needs of the consumer through preliminary and detailed market studies, customer tests, field trial, and test markets. Studies have shown that when these marketing actions are employed projects have a 70% higher market share that those with poor marketing actions (Cooper, Edgett, and Kleinschmidt, 1998). New products aimed at international markets must have international requirements built-in to their development process from the start to compete successfully (Cooper and Kleinschmidt, 1990). In order to incorporate international requirements into the product an international orientation can be conducted by creating teams with members from different countries and gathering market information from multiple international markets as an input to the product's design (Cooper, 1999).

Another strategy for successful product innovation is the use of empathic design. Empathic design is observation, which is watching customers use products or services, and unlike focus groups this surveillance is conducted in the customer's own environment (Leonard and Rayport, 1997). The techniques of empathic design are

gathering, analysing, and applying information gleaned from observation in the field. By observing the users we gain at least five types of information that cannot be gathered through traditional methods of information gathering (Leonard and Rayport, 1997) and they are:

- Usability of the product
- The interaction of the product with the user's environment
- User customisation
- Intangible attributes of the product
- Unarticulated user needs.

The information gathered through empathic design is beneficial because it is relatively low risk, and the information gathered is very reliable and useful for new product innovations.

2.6.3 New Product Launch

Effective product launch is a key driver of top performance and the launch is often the single costliest step in new product development (Maidique and Zirger, 1984). Successful product launches have often been found to be related to perceived superior skills in marketing research, sales force, distribution, promotion, research and development, and engineering (Di Benedetto, 1999). Strategic activities that are strongly related to successful launches are having multi-functional teams making the key marketing and manufacturing decisions. Another activity is getting logistics involved early in the planning stage so the product can be successfully launched (Ottum, 1996).

There are several tactical activities related to successful product launches such as a high quality of selling effort, advertising, and technical support. In addition to the above methods, good launch management, and excellent launch timing relative to customers and competitors leads to product success (Ottum, 1996). There exists a close relationship between product performance, value delivered to customers, and success rate (Lillien and Yoon, 1990). Information gathering activities of all kinds, such as market testing, customer feedback, advertising testing are vital to product launch. Market testing throughout the new product development process gives key information about the customer adoption and allows a firm to finalize its marketing strategy.

Data collection instrumentation for information about product launch can be collected through mail surveys, where respondents can be asked to choose a single product that is characteristic of the firm at the time. However the limitations of this method are a possible low response rate to the survey. In order to analyse data about product launches it can be classified as successful or unsuccessful according to four success measures used (Di Benedetto, 1999). Thus product launch is almost always costly, and risky, and a complete launch strategy requires both strategic and tactical launch procedures (Hultink, Griffin, Hart and Robben, 1997). Thus the timing of the launch as well as tactical and strategic activities related to the launch must be implemented correctly in order to improve the chances of success for the product.

2.6.4 Marketing Products in Non-Profit Organizations

A non-profit organization is defined as an organization that exists to achieve some other goal other than the usual business goals of profit, market share or return on

investment (Lamb, Hair and McDaniel, 2000). Non-profit sectors such as the Biomedical Engineering Service of the RHNd rely on the revenue generated from their products and services, such as the MATRIX in order to sustain themselves. Thus, it is imperative to understand the concepts of non-profit organization marketing.

Non-profit organization marketing is defined as the effort by non-profit organizations to bring about mutually satisfying exchanges with target markets (Lamb, Hair and McDaniel, 2000). Although non-profit organizations differ in size and functions, there are certain general guidelines that apply to all non-profit organizations about marketing concepts. The primary task of the organization is to identify the customers they wish to serve or attract and these customers are often referred to as patients, clients, members or sponsors. Based upon the clientele, the non-profit organization wishes to target, it is imperative that they identify their objectives. Once they have established their objectives, the organization must develop, manage and eliminate programs and services and decide on the fees to charge for their services.

In order to increase public awareness about the services the organization offers, they should communicate their availability through brochures, signs and advertisements and announce events when they will offer their services. Creating new market spaces requires a different pattern of strategic thinking and instead of looking within the accepted boundaries that define competition, one must look systematically across them, this will ensure a breakthrough in an unoccupied territory (Kim and Mauborgne, 1998). Thus, non-profit marketing is unique compared to for-profit marketing as it involves the setting of marketing objectives, the selection of target markets and finally the development of appropriate marketing mixes (Lamb, Hair and McDaniel, 2000).

Non-profit organizations do not have objectives of making profit like most businesses do but rather to generate sufficient funds to cover their operating expenses. From the funds that they generate, they are expected to provide equitable, efficient and effective services that satisfy the wants and needs of the community they cater to. This community could include users, buyers, influencers, the media and the general public. Non-profit organizations therefore cannot measure their success based upon the financial terms. They have to taken into consideration whether they are fulfilling the needs and the wants of the community. One of these considerations is the need of the user. The user need is a description in the user's own words of the benefit to be fulfilled by the product or services (Griffin and Hauser, 1993). Fulfilling all the possible user needs is not an easy task for a non-profit organization to complete, because they lack the funding of a private firm. These lacks of a solid financial bottom line thus make it difficult for non-profit organizations to prioritise their objectives, make decisions and evaluating their performance. They often have to use approaches that are different from those that are used in the private sector.

There are three issues relating to target markets that are unique to non-profit organizations. The first issue is targeting apathetic or strongly opposed targets, which involves non-profit organizations targeting those audiences that are strongly opposed to receiving their services. The second is the pressure to adopt undifferentiated segmentation strategies, where they have to deal with the pressure of serving the maximum number of people targeted by targeting an average user. The problem with developing a service targeted to an average user is that there are hardly many average users for non-profit services. The last issue that is unique to non-profit organizations is

complementary positioning, where they must complement other non-profit organizations rather than compete with them. In order to balance other organizations, they must identify underserved market segments and develop marketing program that satisfy the need of this segment rather than to target those people that will bring most profit to the organization.

Thus, we see that several unique characteristics distinguish non-profit marketing strategies, including a concern with social behaviour and services rather than looking at the profit generated from manufactured goods. They have to study a difficult, undifferentiated target market and a complex product that may have only indirect benefits and bring out very low involvement from the community. Along with evaluating a difficult market, non-profit organizations also have to understand that some user needs have higher priorities as compared with others (Griffin and Hauser, 1993). Furthermore there is a need to deal with a relative lack of resources for promotion and prices are only indirectly related to the exchange between the producer and consumer of services.

In order to assess the strengths, weaknesses, opportunities and threats of the MATRIX, it was vital that we understood the marketing concepts behind this product and the audience it was targeted for. The audience for the MATRIX known as the buying centre consisted of users influencers of the product.

2.6.5 Buying centres

To gather data about the strengths and the weaknesses of the MATRIX besides understanding the marketing concepts, we had to define its target audience, i.e. the buying centre. The buying centre comprises of users and influencers of the product and in

order to make recommendation on how to market the MATRIX, we had to grasp the perspectives of the users and influencers of this product.

A buying centre includes all those persons in an organization who become involved in the purchase decision (Lamb, Hair and McDaniel, 2000). The number of people involved in a buying centre varies with the complexities and the importance of the purchase decision. The composition of the buying centre usually changes from one product to another and sometimes even in the various stages of the buying process. The complexity of the buying centre is increased, as it does not formally appear on organizational charts. This is primarily because people are dropped and added to the buying centre based on the relevance of their talent and contributions to the buying decision at hand.

Users are defined as members of the organization who will actually use the product (Lamb, Hair and McDaniel, 2000). Users are often known to initiate the buying process and are the most influential people to help define product specifications. Successful product launch depends upon understanding user needs and how quickly will the user needs change (Hughes, and Chafin, 1996). The market value of the product depends upon how great is the need that potential customers have for this product (Hughes, and Chafin, 1996). Buyers or purchasers are defined as the people who actually negotiate the purchase (Lamb, Hair and McDaniel, 2000). It could be anyone from the president of the company to the purchasing agent and depends upon the buying decision at hand. Influencers of the product are defined as people who influence the buying decision. They often help define specifications and provide information for evaluating

options. Technical persons are especially important as influencers (Lamb, Hair and McDaniel, 2000).

The implications of the identifying the buying centre for any given product is to realize the importance of who is involved in the decision-making process and the criteria used to choose each member. In our project, we identified the users and influencers of the MATRIX seating system in order to understand who was involved in the decision-making process of this product. In order to assess its strengths, weaknesses, opportunities and threats, it was also important for us to identify the buying centre of this product and understand their standpoint on the MATRIX.

2.6.6 New Product Evaluation

New product development is a dynamic and lengthy process starting from the creation of an idea leading up to product launch. It is important that a product evaluation is carried out during each stage of development (Ozer, 1999). New product evaluation can be conducted at five major stages (Mahajan and Wind, 1988):

- Concept testing
- Prototype testing
- Pre-test market
- Test market
- Launch

The concept testing stage is concerned with assessing the consumer's reaction to a new product concept and determining the market size. At the prototype testing stage a prototype of a new product is evaluated. A prototype is an initial, working model of the

product and it is not designed for aesthetics but rather to test for functionality. The pre-test market stage deals with the simulation of a shopping environment, and measures reactions of potential buyers to a new product. The test market stage consists of an evaluation within a limited product launch, and is the final step before the full-scale product launch. Lastly the launch stage involves predicting the future sales of a product by using early sales data (Ozer, 1999).

New products can be evaluated for a number of different purposes such as predicting new product market performance in terms of product awareness, trial, total sales, and product life cycle. These can be evaluated to discover relevant marketing attributes of a new product as well as understanding the overall market environment in order to determine emerging trends and lifestyles (Ozer, 1999). Evaluating new products has shown that 63% of products that were tested passed the pre-test screening, and 66% of those were subsequently successful in the test market (Shocker and Hall, 1986). These numbers cannot be generalized to every company and product, because different companies face different environments, and follow varied marketing, and new product strategies. To conclude, new product uncertainties can be reduced by using a combination of evaluation methods as they provide different perspectives about the product, and provide managers with the necessary information to make informed decisions about the product before it passes the concept stage (Boulding, Morgan and Staelin, 1997).

The need to understand new product development, innovation, and evaluation was directly linked with our project, as the MATRIX was a potential product that might be marketed by the Biomedical Engineering Services department. This section provided us

with the insight about the best possible ways to market new products and the knowledge that evaluation of the new product is as important as its marketing. We also studied the buying centres as we hoped to gain the perspectives of users and influencers about the MATRIX. Thus, this section was crucial for our group in order to understand the marketing environment that we were operating at in London.

To recapitulate, our literature review consisted of an overview and functioning of the National Health Service and understanding the health care environment and the operation of non-profit hospitals. In addition to that, the background literature also covered a description about the MATRIX and all aspects of new product development such as production innovation, product launch, product evaluation, product development and finally marketing with aspect to non-profit organizations. Our literature review also included sections about the Royal Hospital for Neuro-disability and information about the city of London. We incorporated all these sections into our project as they had direct relevance to our problem statement and we believed that with this knowledge we would be well informed to deal with our agency, sponsor and the problem statement at hand. Thus, the background literature provided us with a strong base for our methodology that is discussed in the next section of our proposal.

III. Methodology

The methodology section of a project typically reports what was done during the course of the research project and is a step-by-step explanation of how the data for the research was gathered and how it was analysed. The outline of our methodology is as follows:

- Statement of objective
- Our procedure upon arrival at the Royal Hospital for Neuro-disability
- Interviewing
- Sampling methods and possible sampling errors
- Pre-testing
- We identified the stakeholders of the MATRIX to be users and influencers and discussed the following for each of them:
    - Sampling methods
    - Interviewing technique
    - Pre-testing method
    - Follow-up efforts
- Data collection and Organization
- Content analysis
- Market Share and Costing Information

Thus, our methodology was a step-by-step explanation of the process we used to gather data in our research project. It is important to include this section in the report as it

explains to the readers how the research was carried out – in other words, what the data consisted of and how data were collected, organized and analysed (Berg, 2001).

3.1 Objective

The objective of our methodology was to gather, organize and analyse data about the strengths, weaknesses, opportunities and threats of the MATRIX from the perspective of decision makers involved in buying and selling the product. In order to aid our understanding of the MATRIX product, the background data in the previous section provided us a strong information base to develop an effective methodology. To fulfil our objective, the information that we gathered dealt with four different divisions of the MATRIX:

- Revenue generation
- Technical aspects
- Training
- Support and Service

It was important that the methods we implemented to gather data were sensitive to the nature of the information that our group gathered to prevent competitors' access to valuable intellectual property. After gathering the data about the MATRIX in the four different divisions mentioned above, we produced a sales tool for the Biomedical Engineering Services department at the Royal Hospital for Neuro-disability that evaluated the opinions of different stakeholders. The sales tool for the MATRIX product included data about the strengths, weaknesses, opportunities and threats of the product and recommendations on its marketing strategy. In turn, the data that we produced for the

hospital will help them make more informed decisions about how the MATRIX special seating technology can become a major aid in the special seating needs of the disabled.

3.2 Work plan upon arrival at RHNd

Upon our arrival at the Royal Hospital for Neuro-disability, the first week was spent mainly orienting ourselves with the hospital since we had little knowledge of the how the hospital functioned and the people involved with MATRIX. After we oriented ourselves to the hospital and we identified people involved in the decision-making process of the MATRIX. In the first week at the RHNd, we met with our sponsor several times to learn names of contact people and based on the names that he had given us, we began to collect contact information for the people he had mentioned. We generated a list of the external and internal individuals directly involved with selling or using the MATRIX. There are wheelchair services in Britain who deal with the MATRIX wheelchair and we identified such services in the London area and began our preliminary contact with them. Another method we employed to gain contacts is by reference sampling, which is the best way to locate subjects with attributes necessary to our study (Berg, 2001). It is also an excellent technique to employ when dealing with sensitive subject matter, which the MATRIX is. Thus, it was crucial in our first week at the RHNd that we identified several people with relevant characteristics to our project and then asked them for names of other people who possess the same attributes as they do (Berg, 2001).

3.3 Interviews

Interviewing is defined as a conversation with a purpose (Marshall & Rossman, 1999). The method we had chosen to extract information from the decision makers involving in buying and selling the MATRIX was through interviewing. The main types of interviews that conducted with our contacts were standardized (formal or structured) and semi standardized (guided semi-structured or focused) interviews. The standardized interview uses a formally structured schedule of interview questions and interviews are required to ask subjects to respond to each question (Berg, 2001). We decided to use this method of interviewing for some of our interviewees as we had a fairly solid idea about the information we wanted to gather during the interview (Schwartz & Jacobs, 1979). Standardized interviews consist of questions that have been worded in a way that allows the interviewee to understand clearly what is being asked and every question in this type of an interview clearly relates back to the subject. Thus, standardized interviews are aimed to extract the subjects' opinion about their thoughts, ideas and opinions about the study-related issues.

The second type of interview that we conducted in order to extract information about the strengths, weaknesses, opportunities and threats of the MATRIX wheelchair seating system was semi-standardized interviews. This type of an interview is not completely structured nor is it entirely unstructured either. A semi-standardized interview involves the implementation of a number of predetermined questions and/or special topics. These questions are typically asked in a systematic and orderly manner but the interviewers are allowed the freedom to probe far beyond the answers to the questions that had been prepared (Berg, 2001). We decided to use semi-standardized interviews

since we would be learning new information about the MATRIX product and sometimes, we had to probe beyond the structured questions to learn the latent opinions of the interviewee. When using semi-standardized interviews, it was important that they must be formulated in words familiar to the people being interviewed i.e., in the words of the subjects. Thus, semi-standardized interviews are aimed at a deeper understanding of the interviewee's perspective on the subject at hand.

Since we would be conducting face-to-face interviews and telephone interviews, it was essential that we were proficient in the use of an interview schedule. An interview schedule consists of instructions to the interviewer together with the questions to be asked and if they are used, response options (Singleton, Straits & Straits, 1993). Our objective of the interview was to collect information about the strengths and the weaknesses of the MATRIX wheelchair seating system and thus in our interview schedule we had to consider the kinds of questions we wanted to ask and the sorts of answers we expected to receive from the interviewees.

We decided to use open-ended questions in our interviews, which are questions that require respondents to answer in their own words. In addition, question formats and the order of questions to be asked were also a part of our interview schedule. All our interviews consisted of essential questions about the MATRIX wheelchair. Essential questions are concerned with the central focus of the study and they may be placed together or scattered through the survey, but they are geared toward eliciting specific desired information (Berg, 2001). We also asked our interviewees probing questions about their personal experiences with the MATRIX wheelchairs. Probing questions, provide interviewers with a way to draw out more complete stories from subjects.

Probing questions include questions like "Could you tell me more about that?" "What happened next?" or simply, "How come?" Probing questions allowed us to learn more about the interviewee's experiences with the MATRIX and thus learn about its strengths, weaknesses, opportunities and threats from a personal point of view.

In order to extract information from the decision-makers involved in buying and selling the product, we had decided to conduct face-to-face interviews with as many people as possible and with all the rest, phone interviews. Face-to-face interviews have a number of advantages, one of the most important being a higher response rate (Dillman, 1978). A higher response rate is better as it means that less bias is introduced into the data as a result of non-participation of sampled persons. Most face-to-face interviews are of one hour's length and one can use visual aids in face-to-face interviews. We hoped that our interviewees would give us visual information about the MATRIX such as pictures of the product. Telephone interviews may provide not only an effective means for gathering data but also in some instances owing to geographic location, the qualitative telephone interview is to reach a sample population that is in geographically diverse locations (Berg, 2001). However, in order for telephone interviews to be extremely productive it was essential for us to have specific questions planned out. We conducted some interviews with people who we had established a rapport with through our sponsor and this made the interview more productive (Rubin & Rubin, 1997).

Confidentiality in social research is another critical issue that was considered in our project, especially since the nature of the data that we were dealing with was extremely sensitive. Confidentiality can be defined as an explicit or implied guarantee by a researcher to a respondent in social science research whereby the respondent is

confident that any information provided to the researcher cannot be attributed back to that respondent (Berg, 2001). Confidentiality acts as an attempt to remove any trace of the respondent from the records. There are two types of confidentiality and in our project we provided explicit confidentiality to our respondents. Explicit confidentiality involves the researcher assuring the respondent through written words or a verbal agreement that clearly states the level of confidentiality to be maintained in the research. By assuring our respondents their confidentiality, we are assuring them no risk to their personal or professional lives by participating in our study. By providing our respondents with a high level of confidentiality, they were more willing to participate and provide us with information about the MATRIX wheelchair. Since we were dealing with sensitive information, by assuring us of their confidentiality, the risk of sensitive data getting into the wrong hands was greatly reduced. We assured our respondents of confidentiality by getting them to sign confidentiality agreement forms and we had decided not to disclose their individual identities in any reports of the study and not divulging information to persons requesting it without our consent.

Thus by assuring our respondents of a high level of confidentiality, we were keeping with the unwritten rules of social science research. Indirectly, we were also protecting fellow researchers from any sort of litigation. The explicit confidentiality that we had assured our respondents of had a two-fold purpose. Firstly, it increased their willingness to participate in our study. Secondly and more importantly, it protected the Biomedical Engineering Services department of the hospital as it ensured the data collected in the interviews would remain within the hands of the hospital. We had assumed that all responses were completely confidential unless mentioned otherwise. We

had also made the assumption that all participants in the research would enjoy and expect confidentiality unless stipulated otherwise.

Finally, in order to ensure that our interviewing process was successful it was necessary for us to know about the ten commandments of interviewing (Salkind, 1996).

- Firstly, it was important that we remembered to begin the interview without chatting with our subjects in order to build a comfortable rapport.
- Secondly, it was essential to remember what the purpose of the interview was and collect information pertaining to the subject at hand.
- It was also vital that we maintained a natural, confident attitude with our interviewee.
- Fourthly, we had to demonstrate that we were listening to the subject.
- Fifthly, the dress code for the interview was important and the thumb rule was to dress one above the audience.
- The sixth rule to successful interviewing was to choose an appropriate place for the interview.
- In order to gain the maximum amount of information from the interview, we would also have to ask probing questions sometimes to extract more information from the interviewee.
- It is also essential to be respectful and courteous and remember to thank them after the interview by sending them a thank-you note.
- Finally, the most essential strategy to a successful interview is to practice several times by conducting as many interviews as possible.

3.4 Sampling methods

Sampling can be defined as the process whereby a subset of items is picked from a set, and done so using a systematic process (Ott & Mendenhall, 1987). For our project, we used reference sampling and purposive sampling to obtain interviews with the stakeholders of the MATRIX. Reference sampling is a qualitative sampling method and is a technique where the group being studied self-defines the sampling technique (Scheaffer, Mendenhall & Ott, 1995). This type of sampling is sometimes known as snowballing and the purpose of this type of sampling is two-fold: to allow a frame to self-define and thus provides context and depth, and secondly to remove researcher selection bias. The actual technique of reference sampling is very simple and after identifying the frames, a single person is interviewed within the frame. At the conclusion of that interview, the respondent is asked to name two people who would be willing to interview. Likewise, the next respondent is asked for two more names and the problem of sample size is solved when either the frame begins to provide the same references or the respondents begin to give similar answers. One must remember that with reference sampling that the sample is highly biased toward the views of those selected but these biases can be accounted for by triangulating the reference sampling. This can be done by purposively picking several different types of people and applies reference sampling to each separate frame. In this process, each frame covers for the other frame's fundamental bias and a more accurate picture is provided.

Purposive sampling is when the researcher chooses the sample with explicit attributes in mind, with the intent of providing in-depth analysis of those attributes of those attributes and how they relate to the selected individual. (Scheaffer, Mendenhall &

Ott, 1995). We decided upon using purposive sampling primarily with certain users of the wheelchairs, as we would have to decide upon the sample based on their ability to communicate with us. In purposive sampling, the researcher simply decides upon the selection attributes and applies the sample. However, in this method, there is a great deal of researcher bias that cannot be eliminated very easily. Since our goal was to gain both hypothesized and unanticipated meanings, this method of sampling was useful.

We had considered two other alternatives before deciding on reference sampling. The first was probability sampling, which always involves the process of random selection at some stage (Singleton, Straits & Straits, 1993). However, this was not a feasible option for us, as we did not know the sample size of the population and also due the sensitive nature of data that we were handling. Probability sampling is based on the notion that sample can be selected that will mathematically represent subgroups of some larger population (Senese, 1998). The second alternative was convenience sampling that is a technique where the researcher basically talks to whoever will talk to him/her (Mendenhall, 1998). Because of this method's inherent tendency for emphasizing biases of the interviewer we eliminated it as a primary option.

The goal of sampling was to provide us with a systematized method whereby participants in a social science project were selected. Sampling intends to remove biases and provide more accurate results. It also allowed us to remove researcher selection bias, allowed for accurate interpolation of meaning and allowed respondents to provide depth of context and a variety of answers from the respondents.

In order to ease the reading of our sampling methods, we have included a table on the following page that delineates our sampling methods for the population chosen, the frame identified and the procedure that we adopted.

Group	Sampling Method	Frame	Procedure
Users	Purposive Sampling	Patients who are able to communicate effectively.	Respondents in this category were identified with the help of our liaison.
Influencers	Reference Sampling	Internal Hospital Staff (OT, PT)	Respondents were initially identified with the help of our liaison and then they were asked for two more references.

3.5 Pre-testing

Pre-testing a survey instrument consists of administering it to a small number of persons having characteristics similar to those of the target group of respondents (Singleton, Straits & Straits, 1993). The pre-test group should be synonymous with the group that we are conducting the interview on. Ideally, pre-testing involves at least two steps. The first step involves, the schedule being critically examined by people familiar with the study matter. This step allows for the identification of poorly worded questions and questions revealing the researcher's biases or blind spots. The second step in pre-testing involves several practice interviews to assess how effectively the interview will work and whether all the information sought after will be obtained (Chadwick, 1984). Thus, careful pre-testing of the interviews will save a lot of time and cost in the long run.

3.6 The stakeholders of the MATRIX

To acquire the information for our project, we employed a number of marketing techniques and social science methods. First, the stakeholders were divided into three market groups: users, buyers and influencers, also known as buying centre (Clark & Wheelwright, 1993). The division was based on the information that we wish to obtain from them. The information obtained from users was the most substantial data we gathered. This information was of great importance because users have the greatest influence on whether a product is purchased (Lamb, Hair and McDaniel, 2000). Influencers provided us with expert opinions on the product that the other stakeholders were not be able to provide. At the initial stages we had begun to investigate the buyers of the MATRIX product as well but as the focus of our project changed, we did not include them in our data collection due to the sensitive nature of information that we were dealing with. Finally, we evaluated how each of the groups perceived the MATRIX technology in their respective areas. Based on these points of view we made effective recommendations on the marketing of the MATRIX technology.

3.6.1 Users

Users are defined as patients directly benefiting from the MATRIX wheelchair (Clark & Wheelwright, 1993). These are neuro-disabled people who actually need the wheelchair in their day-to-day lives. Specifically users provided us with direct feedback on how the product solved their needs and where it was deficient. Initially we did not

know how much direct communication we were able to have with users. However, further discussions with our sponsor lead to him giving us contact names and setting up interviews with primary users of the MATRIX and the family of these patients.

For users, we had decided upon using purposive sampling, which is when the researcher chooses the sample with explicit attributes in mind about the sample population. We had used this method only for the users, as we wanted to select those people who could communicate effectively with us. When a person is neurologically disabled, speech becomes difficult and in the best interests of the respondents we had to choose just those who were able to communicate effectively with us. We understood that there was there was bias associated with this method of sampling and the way we triangulated this way by interviewing influencers of the MATRIX wheelchairs.

After establishing our sample population, the next step was to gather data from the people in our sample group. We had chosen to conduct standardized interviews with users. Since finding a suitable candidate was problematic because of the communication problems noted above, we were only able to use purposive sampling and found suitable candidates for our interviews with the help of our liaison. We had chosen to use standardized interviews because the nature of the questions tended to be very specific and to the point (Berg 2001). This allowed the candidates to easily answer our questions, as the responses were shorter and to the point. Pre-testing also ensured that the language and sensitivity of the questions was appropriate. Since this method was successful, the data we gathered were the best firsthand opinions we were able to acquire.

At the end of our interviews, we provided the interviewees with our contact information if they felt the need to get in touch with us in the future. We also reconfirmed

their contact information in order to keep our records as updated as possible. As research emissaries, it was important that we are cordial and remember to thank the interviewee so that we did not close doors for future researchers.

3.6.2 Influencers

Influencers are defined as those people who have indirect influence over the purchase of the MATRIX wheelchair (Clark, & Wheelwright, 1993). In our project, we defined the influencers to be those people who assist the patients using the MATRIX wheelchair. Their roles may be helping the patients in and out of the wheelchair, forming the wheelchairs to fit the individual patients, or any other role where they interact with the MATRIX in an assisting role but do not employ its benefits directly. They play an important role in the acceptance of the MATRIX wheelchairs as their opinions provide a basis for decision to be made about the MATRIX wheelchairs.

Influencers such as the physiotherapists and the occupational therapists provided us with the majority of the information, which was how users of the MATRIX feel about its strengths, weaknesses, opportunities and threats as a special seating wheelchair and the performance of the MATRIX wheelchair as compared with other options. The sampling method chosen to select participants from the secondary user groups was primarily done through reference sampling. As mentioned previously, reference sampling is the act of gaining participants for interviews by contacting someone in the field and having them give possible sources. From this point each new source interviewed is asked to reference any other sources they know might have input on the topic (Berg, 2001). In support of our choice, Lee (1993) finds that reference sampling is quite appropriate in

cases such as this. Another benefit that reference sampling was that it provided access to other candidates within our frame (Berg, 2001). The frame is the actual group of people having the study conducted on. Since we were in contact with people in our frame a lot, a working relationship allowed us to establish more contacts with similar information to those already in our frame of study.

Once we had established our sample population, we began to schedule interview times with the influencers of our project. The first step to ensuring the success of the interviews was to make sure our participants want to be a part of our research. As in any social science research, demonstrating to the participants that the benefits of participating and providing honest responses outweigh the risks was the first step to getting honest answers. Areas that affected this perception included how we were introduced to the candidate, how we initially contacted the candidate, what we wore during the interviews, and how we structured the interviews. In our situation, our sponsor made the first contact with possible interviewees. To build a rapport with the interviewee we provided a letter explaining why we were conducting these interviews. The letter highlighted the importance of the candidate's participation in our study in order to increase the perceived benefits for them. Furthermore we ensured the strict confidentiality of the interviewee by erasing their name from all records after the interview was conducted and analysed and also guaranteed this by a verbal agreement with the interviewee.

Once initial contact was established and the interview time was fixed we chose a place to conduct the interview in. A private area was ideal in case the interviewee was nervous about the content of the interview (Berg, 2001). To ensure that the area was appropriate we asked the interviewee their opinion about it with enough time to change

areas. After the room was confirmed our attire for the interview was chosen. We chose to dress as though we were hired consultants to the RHNd and thus wore formal clothes. Presenting a professional appearance conveyed the idea that this was a professional study and we earned the interviewee's respect. If we had treated the interview casually the candidate would have got the message that the project did not deserve their full attention and we were liable to lose potential data from the candidate.

Along with our physical appearance it was also important how we portrayed ourselves to the respondent and the level of sophistication we demonstrated with the MATRIX technology. We had chosen the role of the sophisticated sympathetic. The sophisticated sympathetic comes across as someone who is knowledgeable about a topic and sensitive to the concerns of the respondent during the interview. Choosing the role of sympathetic was an easy choice because if we showed that we did not care about what the respondent telling us it would have been unlikely that they would provide us with the information we needed. On the other hand, the level of sophistication we presented was not so simple. We wanted to act as knowledgeable about the MATRIX itself but not about the problems that neuro-disabled patients had with their seating arrangements. If we did illustrate that we were overly knowledgeable about their seating problems it was likely that the respondent shared less information with us assuming we were already aware of their problems. We ensured that both of these roles were met by inserting phrases in a genuine tone of voice such as, "Really? I was not aware of that. That is very interesting", we also used echoing such as "I know what you mean" (Taylor & Bogdan, 1998). These techniques as a sophisticated sympathetic increased how interested the

respondent was in the interview and the level of depth that they provided in their responses.

Using this role we developed semi-standardized questions and used funnel interviews as our technique. We recorded some of our interviews with the consent of our interviewees and used them for transcription purposes. The technique of funnelling an interview is the act of initiating the interview with very broad questions, and as the interview progresses and the interviewer builds a rapport with the interviewee, the questions continue to focus until the desired questions are answered. This technique allowed for a much greater reliability of information, because the interviewee didn't necessarily know what the sought after question was and since a rapport was built between the interviewer and interviewee, it was less likely for there to be discrepancies.

The funnel interview began with broad questions about the interviewer's personal experience with special seating wheelchairs as can be seen in **Appendix B**. The interview narrowed down towards a discussion of what specific problems were most significant in the seating arrangements for the neuro-disabled. The questions eventually narrowed the interviewee on the topic of the MATRIX specifically and how they viewed the technology as a solution to the problems discussed previously. The main focus of the interview was to ask essential questions and gather the critical information from their answers. We ensured that the questions were worded correctly and responses were consistent questions with the same meaning and different wordings were asked. These questions were just variations of essential questions. Lastly, if the respondent was unclear or did not provide enough depth in on of their answers, probing questions were used to extract the required information.

Upon completion of the interviews, we provided the interviewees with our contact information if they felt the need to get in touch with us in the future. We also reconfirmed their contact information in order to keep our records as updated as possible. As research emissaries, it was important that we are cordial and remember to thank the interviewee so that we did not close doors for future researchers.

3.6.3 Buyers

Buyers are defined as those people who make the decision to purchase the MATRIX wheelchair from the hospital (Clark & Wheelwright, 1993). As buyers made a valuable contribution to the revenue to the hospital we needed to understand how they make their decisions as to what products to buy and how they view the MATRIX. As mentioned previously, with the changes that occurred in our project, we were not able to include the buyers in our data collection. However, we have still included information about how we set up interviews with them, as this was a significant effort on our part. We defined them to be individual patients, families and wheelchair seating services within the area.

Buyers provided data primarily on the cost effectiveness, durability, and how the MATRIX compared to other solutions. Data collected from buyers was acquired in an almost identical manner, as the data collected from influencers. Initial respondents were contacted through our liaison or another guide. From there we used reference sampling as we did with the influencers to gain access to a broader scope of the field. We used reference sampling to identify the buyers, especially the wheelchair seating services that had worked with the MATRIX wheelchair system. Not all the wheelchair seating clinics had heard about the MATRIX wheelchairs and it was crucial that we interviewed only

those who had prior experience with the product. We also narrowed down the wheelchair service providers to the London area primarily because of the limitations in the geographical distances that we would have to cover in order to interview them.

Once we had identified all the wheelchair seating services within the London area, we tried to contact them all by faxing a cover letter explaining what we were doing and asking them for permission to set up an interview (**Appendix A**). We confirmed the contact names of the people in charge before sending them the faxes. The letters were followed by a phone call from us to confirm a suitable time for the interview. It was essential for us to send the wheelchair service providers a letter explaining what we were doing as it validated our project and also provided preliminary contact with them.

The interviews were semi-standardized, which is implementing a number of predetermined questions and/or special topics (Berg, 2001). A funnel interview technique was used in order to gain trust with the respondents and collect data that was closer to their true feelings. It was essential that we worded the questions effectively and took into account the language that we were using to gather data from them. As we were dealing with sensitive information regarding the MATRIX, the funnel interview started off broadly talking about their experiences with the MATRIX wheelchair system. We asked questions regarding sales data and cost-effectiveness. As we began to narrow the interview, we asked about its weaknesses and other competitor's products. The final goal of the funnel interview was to collect data on what features they would like improved upon in order for the MATRIX seating system to be a success.

Unfortunately, in the late stage of our seven-week period, the focus of our project had changed and as we were dealing with extremely sensitive data, we did not conduct

the interviews with the buyers and did not include any prior data gathered in our data collection because it would complicate our position in the project due to changes in the RHNd's business plans. We have mentioned how we identified this group and the efforts made to contact them as we believed that it was important to identify the intellectual processes associated with this group.

3.7 Data Collection and Organization

Along with visualizing the progress of the research report, it is also important to take note of how the data collected in the interviews would look like (Lincoln & Guba, 1985). Furthermore, it is important to decide what will be done with the organization data after it has been collected in order for it to be analysed. There are three basic choices for managing and recoding data: an audiotape or videotape recorder, a notebook and pencil and lastly, memory. Using a audio-visual recorders can be very useful as every action or word is recorded, but at the same time, they have the distinct advantage of being extremely obtrusive and making people very self-conscious.

The face-to-face interviews that we conducted were recorded using a tape recorder as it is often recommended (Lofland & Lofland, 1984). By doing this, it allows the researcher to take notes while attending to the subject and does not disrupt the flow of conversation. We also had another person from our group sit in on the interview and take notes. This person was a non-participant observer and recorded body language and physical actions that could not be recorded by the tape recorder. Note-writing strategy is a non-obtrusive strategy that makes the person less conscious. With the phone interviews that we conducted, if the phone system permitted, we recorded the conversation using a

tape recorder. If this were not possible, our researcher would record the notes and would write up field notes as soon as the phone call was over, as the events of the interview would remain fresh in the memory.

Data organization is easier with quantitative data rather than qualitative data. When dealing with quantitative data, the data can be reduced to a computerized form and entered into a database. However, when dealing with qualitative data, it is much harder to organize the data and the mistake often made is to numerically represent the data and then try and quantify it. As Berg and Berg (1993) state, this ceases at once to be qualitative research and amounts to little more than a variation of quantitative data, collection. In our project, all the qualitative data were organized based on the nature of the data that we were dealing with. After we collected raw data, we transcribed the interview (transformed it into written text), corrected it and edited the data and then the organized data were entered into our report.

We entered the data into our report in the form of a SWOT analysis. A SWOT analysis consists of listing the,

- **S**trengths
- **W**eaknesses
- **O**pportunities
- **T**hreats

Organizing our data in this manner had a dual purpose. Firstly, we were able to identify the strengths, weaknesses, opportunities and threats of the MATRIX system in a clear and well-defined manner. Secondly, it allowed us to retain the confidentiality that we had promised our interviewees. We did not include their names in the report and did not link

any information to any particular individual. Thus, understanding how our data was organized and managing the data was extremely important in this project.

3.8 Content Analysis

The content analysis of the various interviews that will be performed during the duration of our project were very important because it determined the actual meanings of what each interviewee was trying to say. Content analysis is the act of determining the actual meanings of responses given during interview situations, and other information gathering sessions (Berg, 2001). Content analysis is the act of using various techniques of observation, which would be conducted while an interview or other type of information gathering session is going on.

Since our project focused completely on the interviewing of subjects it was imperative that our interviewers or other team members were present can and could read the various moods and or feelings that a particular interviewee was emitting. When anyone talks about something they talk in both terms of latent and manifest meanings. Manifest meanings are the actual words that are being said taken at face value however latent meanings are the underlying truths that the speaker actually means when they are talking (Berelson, 1952). Since interviews were being used it was necessary to be able to account for these possible latent and manifest meanings that arose while answering questions. Latent and manifest meanings were one of the reasons to pre-test our interviews because pre-testing helped to eliminate areas of ambiguity from the questions. Manifest meanings, by their very nature are simple to account for because they could be quantified when given a transcript of the interview. Latent meanings however, require

some objectivity and need corroboration with other references to give accurate speculations on true meaning (Holsti, 1969).

In order to do a proper content analysis on an item whether it is a paper, or an in depth interview, there are seven major elements that need to be analysed, and they are, words, themes, characters, paragraphs, items, concepts, and semantics (Berelson, 1952; Berg, 1983; Merton, 1968; Selltiz et al., 1959). Although not all of these relate completely to interviews, many of them do and they all aid in the determining of latent and manifest meanings. The seven major elements are:

- Words are simply a way of gauging if certain key words continue to come up in an interview, possibly signalling a recurring issue.

- Themes tend to be a sentence that is the start of an idea that will be continued throughout a paragraph. Themes can be accounted for in two ways, the counting of initial, or primary themes, or the accounting of all the themes in a paragraph.

- Characters unlike themes are actual people, or persons that come up in discussions of a topic. Like themes these characters can be counted to aid in the analysis of a person.

- Paragraphs are a basic unit of concepts ideas, but they are difficult to use for concept analysis, mainly because each paragraph can contain multiple ideas and this can make it difficult to quantify key points.

- Items are what the interviewee's overall view on a single subject is, or their complete statement on a given topic. This is not necessarily what they actually mean, however it is what they say.

- Concepts are a more advanced method of doing content analysis, because concepts are groups of words that signal to the observer latent meaning of the text or interview (Sanders & Pinhey, 1959). Concepts can be overlooked so when doing interviews it is necessary if possible to record them for later transcription and analysis.

- Semantics, which is taking the understanding of concepts to the next level, by interpreting the affective ness of the concept words used. This means determining whether the words being used are strong or weak in relation to the overall statement (Sanders & Pinhey, 1959).

With our project, in order to perform content analysis on all the interviews that we had conducted with users and influencers, we transcribed the interviews first. We then began looking for words and phrases in respect to the four areas of the MATRIX that we were investigating. These areas were:

- Revenue generation
- Technical aspects
- Training
- Support and service

Once we had identified the words and phrases relevant to these categories we then entered them into the SWOT analysis spreadsheet. During our interviews, we had also taken note of the body language of our interviewees and this helped us gather the latent meanings about what our interviewees were trying to imply.

Content analysis is very helpful in most situations, because it is unobtrusive and it helps extract latent meanings out of interviews and writing (Webb et al., 1981). Research into whether or not person's meanings are manifest or latent can be done without the person's knowledge, making content analysis very useful. However there are downsides to this method. One of the downsides to content analysis is a lack of research sources relevant to the situation. It is possible to be researching a subject that there are no concurring data sources for in order to check the content analysis. This could lead to possible problems in determining latent meaning. Due to this restriction, content analysis can only be used in situations where there has already been some information gathered (Berg, 2001). This unfortunately made our job somewhat more difficult however not impossible, because there were not a lot of sources on our interviewing focus.

3.9 Market Share and Costing Information

In addition to conducting the interviews with users and influencers we had to gather existing market share data to predict the potential market share for the new MATRIX. Our first attempt to gather this information was with the help of our sponsor. Unfortunately, we were not able to gather sufficient information from Dr. Cousins that would allow us to make accurate predictions. Our next option to gather market share was by contacting government agencies that documented information about special seating wheelchairs. We contacted the Medical Devices Agency (MDA) in Blackpool by phone and requested that they send us information about the number of special seating wheelchairs that had been issued until the year 1997. The contact that we had made at the MDA provided us with a reference in the National Health Service. We contacted our new reference and requested again, that the information about the number of special seating wheelchairs be mailed to us.

After making the initial contacts, we sent our references letters explaining the purpose of our study and our need for the information from them (**Appendix C**). The purpose of the letter was to validate our research project and also re-confirm the request for information. In the letter we included our contact information and also thanked them for their time and effort. After faxing these letters, we called our sources two days later to reconfirm that they would be sending us the information that we had requested.

In addition to gathering market share data, we also collected costing information for the new MATRIX from our liaison. He provided us with a large amount of information with varying degrees of relevance to our project. We had to sort through the

information and decide its relevance to our project. On several occasions, we had to meet with our liaison and request him for additional information pertaining to market share in relation to all wheelchairs and profit margins.

In our methodology, we have included information about how we conducted our interviews with the users and influencers. As the focus of our project had changed in the latter half of the term, we could not conduct our interviews with the buyers of the MATRIX. This chapter outlines the methods that we have used to gather our data and the next chapter will discuss the results of the interviews, market share and costing data along with providing an analysis of the information gathered.

IV. Analysis and Results

This section of our project reports the data that we collected through our interviews with the users and influencers of the MATRIX. The outline of our data analysis and results section is as follows:

- A SWOT (Strengths, Weaknesses, Opportunities and Threats) tableau
    - Explanation of the results of the SWOT analysis conducted
- Market share information gathered about the MATRIX
    - Growth and forecasting results
- Costing information
    - Costing information about the parts of the new MATRIX

The results that we present in this chapter form the basis of achieving our goal for the project, which is to provide the Biomedical Engineering Services department with a value proposition for the MATRIX special seating wheelchairs.

4.1 SWOT Analysis

A SWOT analysis typically reports the **S**trengths, **W**eaknesses, **O**pportunities and **T**hreats that an organization is faced with at a given point in time. The different categories are defined as follows, strengths are the areas where the product performs well in, weaknesses are areas where the product is lacking, opportunities are consumer needs that could be filled by the product, and finally threats are areas where the product is subject to competitive products. As we conducted our interviews with the users and influencers of the MATRIX special seating wheelchairs, we were faced with

confidentiality and anonymity concerns that our interviewees expressed. We had guaranteed our interviewees explicit confidentiality and thus, the information gathered from these interviews is best presented in the form of a SWOT analysis.

STRENGTHS	WEAKNESSES
• Adjustable • Allows ventilation • Provides better position for the patients as it is moulded to suit their body • Comfortable • Flexibility • Good for stabilizing patients • Good initial impression • Helped to keep cooler temperatures • MATRIX fits patients well • Open weave • Removable covers • The MATRIX provides mobile support • Versatile system	• Assembly takes a long time • Can look displeasing • Complicated system • Covers do not always provide enough padding • Expensive • Fitting patients can be time-consuming and complicated • Heavy • More static support needed • Need a qualified technician to conduct repairs • Pressure produced on different body parts • Specialized training required to fit patient
OPPORTUNITIES	**THREATS**
• Lack of quality standards when fitting • Communication between patients, therapists and fitting person to achieve a better fit for the patient • If properly prescribed, it can be extremely successful • Mobility with the wheelchair • Providing a training program to better understand the MATRIX wheelchair. • Providing support and service after initial usage of the chair • Useful for patients who need added care	• Cheaper, competitor's products are available • High risk of failure due to the need to be seated correctly the first time around • Need a high level of expertise to fit the product – thus complicated and expensive

FIGURE 4.0: AN OUTLINE OF THE SWOT ANALYSIS

The main strengths, weaknesses, threats and opportunities described on the following pages have been stressed upon based on their frequency of occurrence during the interviews.

4.1.1 Strengths

The strengths of the MATRIX are the perceived assets of this system that the users and influencers have recognized. The six main strengths of this seating system are discussed below:

1. **Adjustability**: Most of our interviewees reported that the MATRIX seating system could be adjusted to suit the patient's body. This was an asset as it allowed the MATRIX to be custom fitted to patients' and thus provided a close snug support mechanism. This feature of the MATRIX was what had distinguished it from other seating systems as it was dynamic and could be moulded to suit the patient's form.
2. **Flexibility** and **Versatility**: The MATRIX system was described by our interviewees to provide "adjustability and flexibility with altering the shape" and also as a "very versatile system". This feature was a definite advantage over other seating systems as the MATRIX wheelchair could be reshaped to suit the changes that might have occurred with the patient's body over a period of time.
3. **Ventilation**: The MATRIX system as opposed to other seating systems provided the patients with ventilation and allowed for air to pass through the wheelchair. The "open-weave" aspect of the wheelchair proved beneficial to the users and

influencers of the MATRIX as it helped the wheelchair users keep their body temperature under control especially in the summer months. Since the MATRIX "has gaps", it allowed for easy cleaning of the wheelchair.

4. **Weight stabilization**: By putting a patient in the MATRIX wheelchair, it helped to stabilize their weight. According to our interviewees, they described the MATRIX to be "good for stabilizing patients" and "helped to keep patients' weight stable". This aspect proved to be a huge clinical benefit for the MATRIX seating system.
5. **Temperature**: This feature of the MATRIX was inter-linked with the "open-weave" of the system. As the MATRIX "has gaps", it helped to keep cooler body temperatures for the patients making them more comfortable in the chair.
6. **Good support system**: The MATRIX provided patients with a good support system thus "achieving things that other systems did not". According to most of the interviewees, this system could be moulded to the shape of the patients' body thus providing a snug fit.

4.1.2 Weaknesses

The weaknesses of the MATRIX seating system are the perceived lacking in the abilities of the system. The six main weaknesses defined by the users and influencers of the system are listed below.

1. **Complicated system**: The MATRIX is a complex seating system this leads to numerous problems with the product. The complexity of this system leads to extended periods of time with the fitting process, requires highly skilled

technicians, creates an added need for quality control measures to be implemented after the patient has been fitted. All these aspects hamper the growth of the MATRIX within the special seating community.

2. **Time-consuming**: From our interviews, we gathered that the MATRIX special seating system took time to assemble and fit a patient. On an average, the process takes about 3 weeks from start to finish and for patients who need this system as an immediate solution this can prove to be an obstacle.
3. **Heavy**: After gathering data about the MATRIX seating systems, we noticed several recurring themes within our data collection and these could be viewed as weaknesses of the system. One repeated weakness was the weight of the MATRIX wheelchairs. It was described to be "heavy" and created problems when the chair had to be pushed around. The load of the patient along with the added weight of the chair proved to be a flaw in the system.
4. **Expensive**: When compared with other seating systems the MATRIX was a more expensive option. This is a perceived weakness of the system as there were cheaper options available that the users and influencers seemed to prefer.
5. **Lack of quality standards when fitting**: From the data gathered in our interviews, there were no quality standards implemented during the fitting of patients in the wheelchair. The lack of the quality control measures required frequent visits with the seating technicians to fine-tune the chair and hindered the perceived performance and durability of the chairs.
6. **Specialized skills required**: In order to fit patients effectively to the MATRIX wheelchairs, the technicians have to be specially trained for this task. The high

measure of skill required to properly seat a MATRIX wheelchair is a hindrance on the acceptance of MATRIX as a seating system.

4.1.3 Opportunities

The opportunities of the MATRIX can be defined as unsatisfied market needs in the special seating community. According to the users and influencers of this product, the three main opportunities for the RHNd are:

1. **Increasing the amount of communication between patients, therapists and technicians**: By improving the interaction between the patients, therapists and technicians, this product has the chance to provide a better fit for the patients. This interaction can also be the key to eliminating a number of quality control issues and improving the overall performance of the product.
2. **Providing support and service after the initial fitting of the chair**: Support and service for the MATRIX wheelchairs can be an opportunity for this chair to have a stronger presence in the market. By providing repair and maintenance for this chair, users and influencers of this chair would find a more attractive option to consider. The RHNd can provide services such as this, because it is an area where they already have a measurable expertise.
3. **Introducing quality control measures when fitting the chairs**: At present, there are no known quality standards that the MATRIX wheelchairs have to conform to when the patients are being fitted. If quality control measures are introduced, this can be an opportunity for the MATRIX special seating systems to achieve a high

level of quality and thus, prove to be a stronger product compared to other wheelchairs. The quality control measures would ensure the RHNd's standards are being maintained throughout all the users of the MATRIX, and therefore increase customer security with the product.

4.1.4 Threats

The threats of the MATRIX wheelchairs are the perceived dangers of losing market share with competitor's systems. From the data gathered in our interviews, the three main threats of the system are identified below:

1. **The need to be seated correctly the first time**: When seating a patient in a MATRIX wheelchair, there is an imperative need for the patient to be seated correctly. This is a perceived threat to the MATRIX seating system as it places a lot of pressure on the technicians and therapists to provide the patients with a good product. Despite this need, in the RHNd's seated MATRIX wheelchairs there are very few improperly seated patients, mainly because the RHNd has the proper staff training and experience to properly seat each individual.
2. **Cheaper, competitor's products are available**: After gathering information from our interviews, we learnt that there are cheaper, competitor products available in the market. We did not learn about their performance compared to the MATRIX but since they are cheaper and provide a similar service as the MATRIX, they can be perceived threats to this product.

3. **The use of the MATRIX is limited**: The MATRIX seating system is designed for use by patients who need a highly specialized treatment. This can be a perceived threat in the special seating community as its use is limited to very small niche.

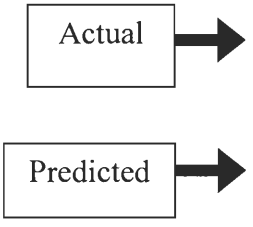
The data from the interviews has been summarized in a SWOT analysis. We have done this to protect our interviewees and abide with their concerns about confidentiality. We learnt of the perceived strengths, weaknesses, opportunities and threats of the MATRIX seating system and gathered information about the opportunities and threats of this product.

4.2 Market Share Data

The market share findings for the new MATRIX were based on forecasts of market growth for the wheelchair. This information allowed us to predict the potential market size at the time of the launch of the new MATRIX for special seating wheelchairs. The MATRIX wheelchair is considered a part of the category of special seating wheelchairs and our findings also included the percentage of special seating wheelchairs that could use MATRIX. With this information in hand, we were able to make a prediction about the possible demand for MATRIX wheelchairs within the special seating community of England. Using an extrapolation of the predicted growth history between the years 1995-1997, we calculated the unit volume of special seating wheelchairs that would be issued. The findings also allowed us to create different scenarios depicting the market for the new MATRIX. These scenarios varied based on the market penetration

desired for the product and the percentage of special seating wheelchairs that could be MATRIX. We believe that these results importance to the Biomedical Engineering Services department for planning possible market sizes for the new MATRIX. The assessment of the market size for the MATRIX will allow the BES to make an informed decision about the production supply based on the demand that we have forecasted.

We contacted the National Health Service that maintains records for Wheelchairs and Mobile Arms Issued. The last year that this publication was issued was in 1997. From the publication, we gathered information about the numbers of special seating wheelchairs issued for the years 1995-1997. The assumptions that we made at this stage of our findings were that the figures that we had gotten from the NHS were an accurate reflection of the market and that the growth pattern for the next several years was similarly increasing. Assuming this growth pattern over the following set of years was necessary in order to be able to properly calculate a value for the possible number of wheelchairs issued for the 2000/2001 year. We also assumed that the numbers that Excel produced were an accurate reflection of the growth of the market. These assumptions helped us come to an important result at the first stage of our market prediction. As can be seen from the table below, we were able to forecast the unit volume of special seating wheelchairs that would be issued from 1998-2001.



Years	Units Sold
	Growth
Year94-95	14,616
Year95-96	14,759
Year96-97	15,748
Year97-98	*16,812.50*
Year98-99	*17,451*
Year99-00	*18114.62*
Year00-01	*18,803*

These results are important for our project because it provided us with a starting point to calculate the possible number of special seating wheelchairs that might be MATRIX. In order to get to our goal, we made the assumption that 18803 special seating wheelchairs *were* issued in 2000-2001 and made this the constant in our calculations. Our sponsor had provided us with information about the predicted number of special seating wheelchairs that might be MATRIX. According to this, 62.10% of special seating wheelchairs could potentially be MATRIX wheelchairs. Once again, we made the assumption that the numbers we had received from our sponsor were an accurate reflection of the market; however, if this prediction were inaccurate, or if the information should change, the tool that we had created to calculate the fraction of special seating wheelchairs that might be MATRIX would easily accommodate. From these findings, we were able to forecast the number of special seats that could be MATRIX.

At this point, we had gathered information about the total number of special seats issued in 2001 and the fraction of this number that could be MATRIX wheelchairs. We used these conclusions to create a variety of market scenarios that could occur at the time of the launch of the new MATRIX. In order to create this varied market scenario, we assumed that there exists a ratio between the market penetration desired to the fraction of special seating wheelchairs that could be the MATRIX technology. The market penetration was assumed to be anywhere between 0-100%. Despite the fact that our sponsor had told us that 62.10% of special seats could be MATRIX, we made the decision to vary this number between a conservative 25% estimate to an optimistic 75% market holding. We had also decided to spread our findings across a broad range of values to account for any possible error that could have occurred during our calculations.

Keeping these assumptions in mind, we set ahead to create the results of our findings about the probable market share holding that the MATRIX wheelchairs might have. All our calculations have been included in **Appendix D**. Using 18,803 as our constant, we calculated the percentage of market penetration desired multiplied by the percentage of special seats that could be MATRIX to give us the number of MATRIX wheelchairs for 2001. As mentioned above, the market assessment tool that we have provided the BES Department with is a starting point for them to use in order to forecast the number of MATRIX wheelchairs required. In order to ease understanding of the relationship between market penetration and the fraction of special seats that could be MATRIX, we have provided a graph on the following page. This graph explains in a pictorial format the potential market demand for the MATRIX given the varying scenarios that could take place.

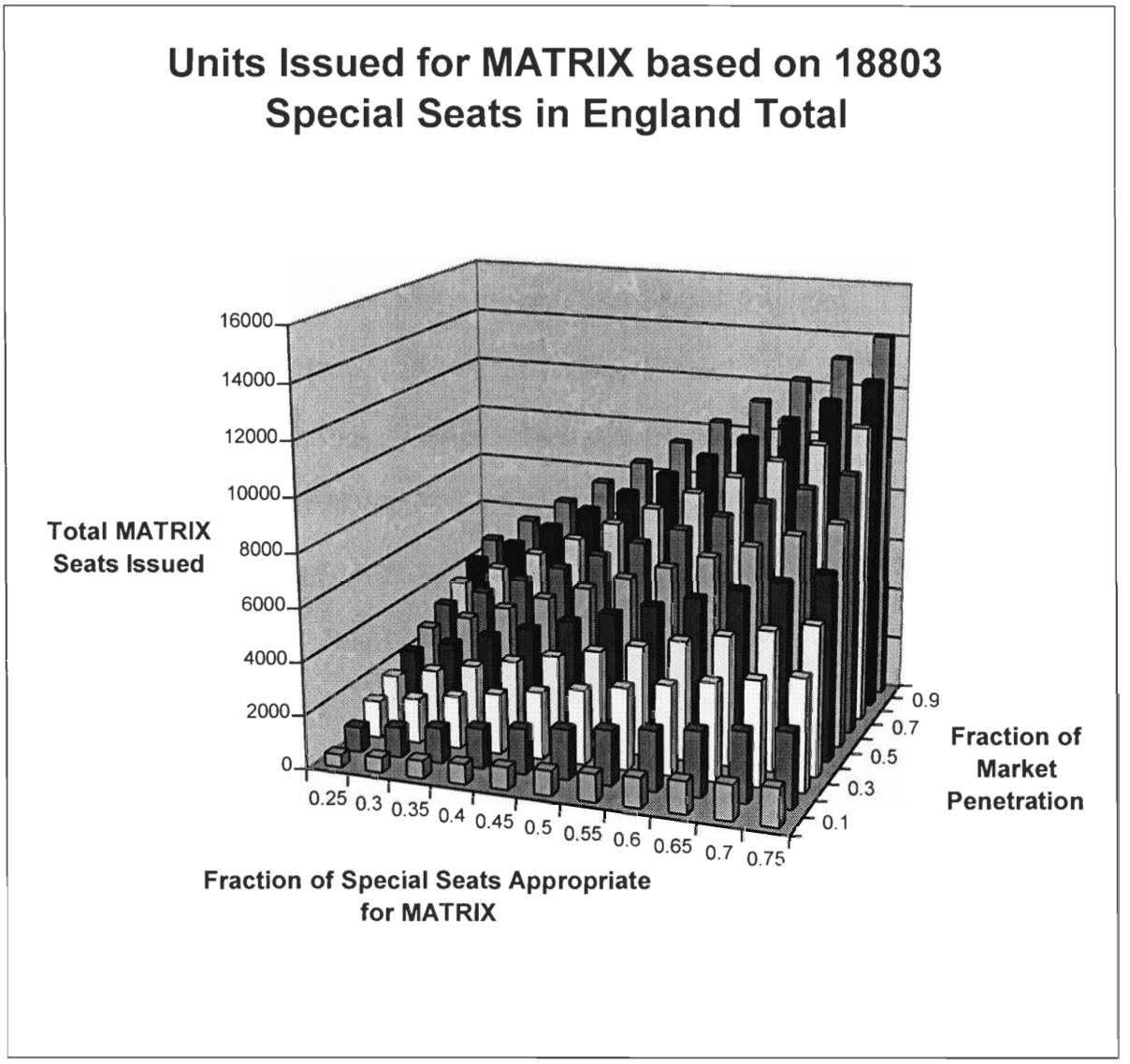


FIGURE 4.1: UNITS FOR MATRIX ISSUED BASED ON SPECIAL SEATS IN ENGLAND

Using this graph, any information about the market penetration for the MATRIX can be calculated. For example, at 10% market penetration and at a conservative estimate that 25% special seating wheelchairs are appropriate for MATRIX, it is estimated that there will be a demand for 470.075 MATRIX wheelchairs. On the other hand, at a 90% market penetration and at a generous estimate that 75% special seating wheelchairs are appropriate for MATRIX, it is estimated that 14,102 will be the demand for MATRIX

wheelchairs. The rationale behind this graph is that it will help the BES predict the number of MATRIX wheelchairs required depending upon the market penetration that they adopt and the fraction of special seats that could be MATRIX at that given point in time.

The graph serves as a visual aid to complement the information mentioned in our report. The tool that we have created will predict the demand for MATRIX wheelchairs in a given market based upon the market penetration chosen and the fraction of special seats that are MATRIX. However, it is important for the BES Department to keep in mind that the predicted demand for the MATRIX is within all of England. Due to the lack of information available, we were limited to predicting the demand for all of England and not area specific. In the following chapter, we have discussed possible studies that the BES could carry out to predict more accurately the demand for the MATRIX wheelchairs.

To summarize, our findings about the market for the MATRIX included information from the years 1995-1997 about the number of special seating wheelchairs issued. We used these statistics to extrapolate the predicted growth history for the years from 1998-2001 for the unit volume of special seating wheelchairs that had been issued. Using the information given to us by our sponsor about the fraction of these that could be MATRIX, we created an assortment of market scenarios. These scenarios were dependant on the fraction of special seating wheelchairs that could be used with the MATRIX and the percentage of market penetration desired by the BES Department. We believe that our results are an accurate reflection of the data gathered in our research. The

tool that we have provided to the BES Department to calculate the number of special seats that could be MATRIX can easily accommodate any changes in the market.

4.3 Costing Information

Besides predicting market growth, we also gathered and re-organized the costing information for the new MATRIX. This information was valuable to our project because the information was not in a readable format. Initially the information was not organized in a logical format and made it more complex to understand all the costs that were associated with the production of the new MATRIX. We decided to re-organize this information based upon the two different sheets that could be used which were stainless steel or spring steel (not using hardening and corrosion protection) Following this breakdown, we further funneled it to identifying the unit costs and total costs for either 8-cavity MATRIX or a 16-cavity MATRIX. Finally, we were provided with the tooling costs associated with the two different sheets produced. In order to justify the tooling costs for each method, we also identified the break-even point that must be reached in order to make the new MATRIX a profitable proposition for the BES Department. The re-organized costing information will ease the pressure for the BES and aid them in making a clear and informed decision about the best possible way to price the new MATRIX so as to make a profit. Our further recommendations to the department have been discussed in the forthcoming chapter.

To facilitate easy understanding of how we reorganized the costing information, we have provided a pictorial representation on the following page. This diagram is

provided in accompaniment to the breakdown of the costing information for the parts of the MATRIX that can be seen in Appendix E.

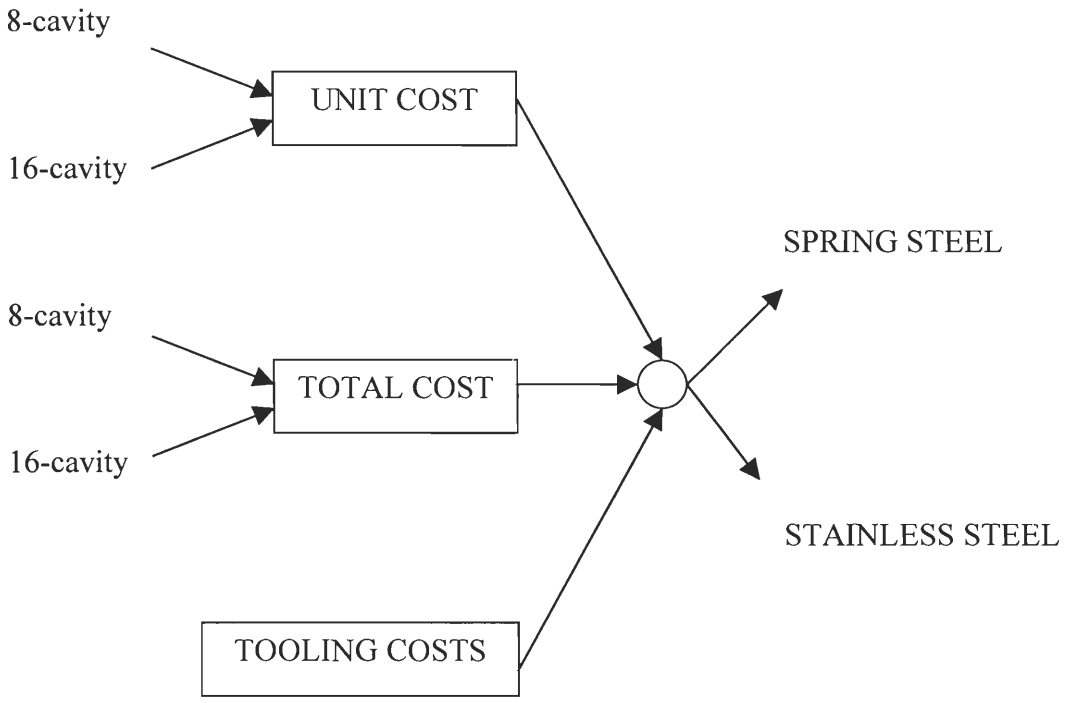


FIGURE 4.2: COSTING INFORMATION FOR THE NEW MATRIX

The reorganized costing information has been included below.

Stainless Steel

		Unit Cost		Total Costs		Difference
	Qty	8 Cavity	16 Cavity	8 Cavity	16 Cavity	
4-ball	275	£0.03377	£0.02587	£9.29	£7.11	£2.17
Trim plate	624	£0.01787	£0.01278	£11.15	£7.97	£3.18
Flange plate	624	£0.03100	£0.03100	£19.34	£19.34	£0.00
Clamp Plate	624	£0.01600	£0.01600	£9.98	£9.98	£0.00
Screw Insert	312	£0.08620	£0.08620	£26.89	£26.89	£0.00
Screws	312	£0.02500	£0.02500	£7.80	£7.80	£0.00
Clear Balls	74	£0.10000	£0.10000	£7.40	£7.40	£0.00
Total Assembly				£10.00	£10.00	
				£101.86	£96.51	£5.35

Spring Steel

		Unit Cost		Total Costs		Difference
		8 Cavity	16 Cavity	8 Cavity	16 Cavity	
4-ball	275	£0.03377	£0.02587	£9.29	£7.11	£2.17
Trimplate	624	£0.01787	£0.01278	£11.15	£7.97	£3.18
Flangeplate	624	£0.02600	£0.02600	£16.22	£16.22	£0.00
Clamp Plate	312	£0.01600	£0.01600	£4.99	£4.99	£0.00
Screw Insert	312	£0.02180	£0.02180	£6.80	£6.80	£0.00
Screws	312	£0.02500	£0.02500	£7.80	£7.80	£0.00
Clear Balls	74	£0.10000	£0.10000	£7.40	£7.40	£0.00
Total Assembly				£10.00	£10.00	
				£73.66	£68.31	£5.35
				Total Difference		
				£28.20	£28.20	0

As can be seen in the figure above, we have organized the information in a logical readable format. After physically re-organizing the information given to us, our results included the difference of the unit costs between the 8-cavity and the 16-cavity and likewise for the total costs. Our findings also provided us with information about the tooling costs for the 8-cavity and 16-cavity. From the breakdown of the costing information per part for the new MATRIX, the results revealed that 2738 sheets of the new MATRIX must be produced to make the 16-cavity tooling costs feasible, other the 8-cavity tooling costs will be cheaper. These conclusions were reached by assuming that the tooling costs that we were provided with were an accurate reflection of the prices for the new MATRIX. We had also assumed that the quantities per part that went into the construction of a single MATRIX sheet were accurate. Based on these assumptions, once again, our results revealed that only if 2738 sheets of MATRIX were produced, the BES would break-even using the 16-cavity. Their best option otherwise would be the 8-cavity since the tooling costs were cheaper and guaranteed that this would pass the break-even point.

Further information from our sponsor revealed that the price for the frame was £150.92 and the price for the labour was £250.00 in order to produce a single sheet for the old MATRIX. Thus, the total frame cost is £400.92. The assumptions that we made at this stage were that all the information that we had gathered from our sponsor was accurate and reflected the pricing of the MATRIX. This information helped us to compare the cost of production for the new MATRIX between stainless steel and spring steel. The results revealed to us that the material used made a difference in the tooling costs and the total costs that would be incurred by the BES. Thus, we determined that for the production of the new MATRIX, the total frame cost was saved, as the frame is not needed for the new wheelchairs. The re-organization of the costing information along with a prediction of the savings involved with the new MATRIX and the number of sheets that must be produced in order to reach a break-even point will help our sponsor make an informed decision about the costing for the new MATRIX.

To summarize, our findings and results section presented all the data gathered in our interviews and the results from our research. We had gathered information about the strengths, weaknesses, opportunities and threats of the MATRIX and this information was presented in the form of a SWOT analysis. We had chosen to present this as a SWOT analysis as some of interviewees had expressed concerns about confidentiality and this was the best way that the information could be presented without the mention of any names. We identified the main strengths, weaknesses, opportunities and threats for the MATRIX based on the frequency of occurrence of topics. In addition to the information gathered in our interviews, we had gathered information about the market share of the MATRIX and used these findings to forecast the growth of special seating wheelchairs

issued. As a part of our results we created different market scenarios that were possible expressed as a ratio between market penetration and the fraction of special seats that could be MATRIX. This information allowed us to calculate the unit volume of special seats that could be MATRIX and allow the BES to calculate the market demand for their new product. Finally, we re-organized the costing information for the new MATRIX and presented it to the BES in a readable format. They will be able to use this information to accurately calculate the price per unit and the different tooling costs that could be incurred. They would then be able to make an informed decision about the most cost-efficient way to produce the MATRIX. The following chapter will discuss the conclusions of all our results and we will provide recommendations to the Biomedical Engineering Services department at the RHNd.

V. Conclusion and Recommendations

The conclusion and recommendations chapter consists of a reiteration and elaboration of the key points and suggestions about how the finds fit into the extant literature of the topical study area (Berg, 2001). The goal of our project was to gather information about MATRIX with respect to costing, market share data and the strengths, weaknesses, opportunities and threats of the product. We assessed the strengths, weaknesses, opportunities and threats of the product from the perspective of users and influencers by conducting interviews and provided the Biomedical Engineering Services a comprehensive marketing package for the MATRIX.

As discussed in the previous chapter, our results and findings consisted of information about the opportunities and threats of the MATRIX. This information about the MATRIX was gathered by conducting interviews within the hospital with the users and influencers of the product. To protect the confidentiality of our interviewees, we organized this information in the form of a SWOT analysis. A SWOT analysis was appropriate when dealing with sensitive information, as we were able to attain the meaning of the information while removing the identity of the interview candidates. Moreover, it yields a strategically relevant framework for commercialisation of MATRIX. Based on the frequency of topic occurrences, we were able to identify congruent strengths, weaknesses, opportunities and threats.

The second part of our results and analysis included information about forecasting potential market share for the MATRIX. We gathered information about the number of special seating wheelchairs issued for the years 1995-1997. Based on these figures, we

were able to predict the numbers until the year 2001 by calculating the exponential growth over the years. One of the key assumptions that we made was that the growth pattern calculated using Microsoft Excel was an accurate figure. Once we had calculated the growth for the year 2001, we calculated the total number of wheelchairs that could be MATRIX. Based on the assumptions made by our sponsor about the fraction of all wheelchairs that could be MATRIX, we calculated the fraction of special seats that could be MATRIX wheelchairs and found this to be 62.5%. In order to account for possible error, we varied this number over 25-75% along with 0-100% market penetration to find out how many units would be sold given the different scenarios. A large portion of our calculations was based on the assumption that the numbers we had got from our sponsor accurately reflected the market for MATRIX. In the future, if these numbers do not accurately reflect the market for the MATRIX or market conditions have changed, then the Excel spreadsheet that we created will be able to accommodate these changes with ease.

The final section of our results and analysis included the costing information about the MATRIX. We were given cost information for the new MATRIX and re-organized this into a better readable format. This information consisted of the pricing for all components for the new MATRIX along with various start-up costs depending upon manufacturing techniques. We analysed information about the labour costs incurred with the production for the new MATRIX and this data combined allowed us to project theoretical costs. One of the key assumptions that we had made was to calculate the number of MATRIX sheets required to compare the costs of production.

The results and data that we had gathered in the previous chapter helped us to make strong recommendations about the marketing techniques that should be adopted for the new MATRIX. In this chapter, we provide recommendations and conclusions about the actions that should be taken with marketing the new MATRIX seating system. We will connect all the information that we have gathered and fulfill the goal of our project, which is to provide the BES with a value proposition for the MATRIX. We also provide further suggestions about problems that the BES might face when dealing with the marketing of this new product and about additional areas that they can investigate as revenue generation possibilities for the new MATRIX.

5.1 3-point Improvement Module for the new MATRIX

The SWOT analysis revealed the main strengths, weaknesses, opportunities and threats. The data gathered from the SWOT analysis has proved its usefulness for the project by allowing us to identify the areas in which the new MATRIX can change the opinions of the users and buyers. Our 3-point improvement module for the new MATRIX shows thus:

1. Quality control
2. Training
3. Support and service

We believe that these three areas namely quality control, training and providing support and service is where the new MATRIX could improve substantially and give the BES an excellent opportunity to become a leader in the special seating market. The BES Department has this unique opportunity because the three areas named above are where

the hospital's proficiency lies. The diagram below highlights the relation of the three main areas of opportunity for the new MATRIX and forms the basis for a cohesive marketing recommendation to the Biomedical Engineering Services department.

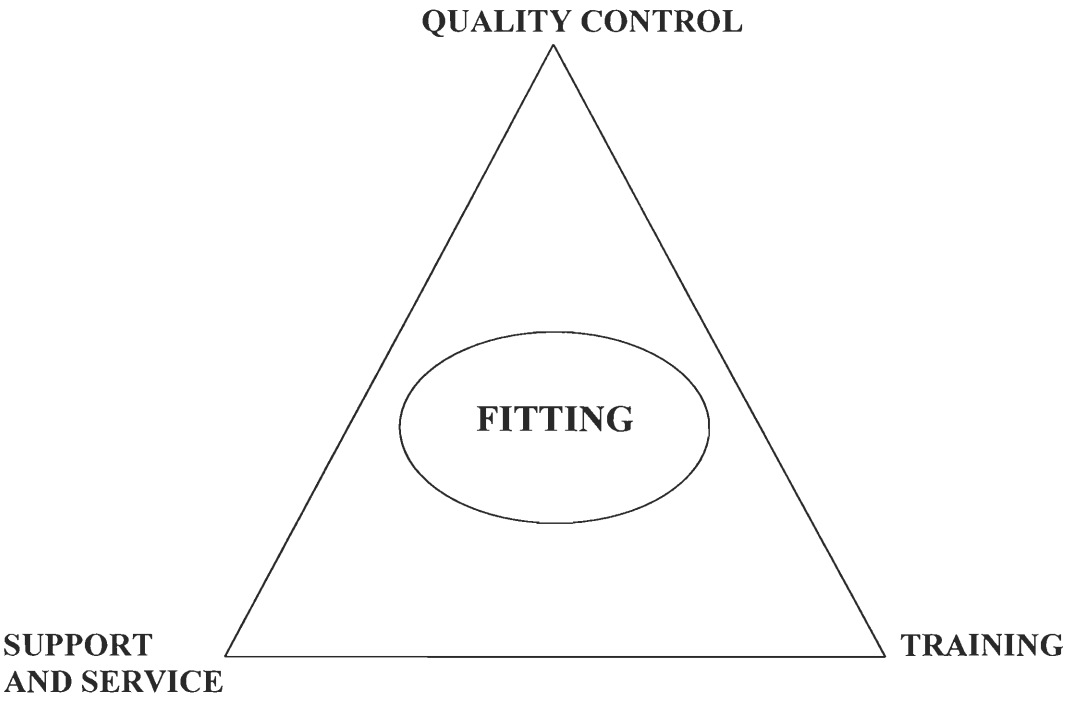


FIGURE 5.0: 3-POINT IMPROVEMENT MODULE

This diagram depicts that each one of the core three points relate to one another and together, they provide a basis for the success of the fitting service. As discussed previously, from the data gathered in our interviews and based on their frequency of occurrence we determined that training, quality control, support and service were the potential opportunities of the MATRIX system. Our 3-point improvement module has the potential to that can give the new MATRIX a chance to make a positive impact on the special seating community and provide a source of revenue for the BES Department.

5.1.1 Training

These opportunities for the MATRIX depicted above have the potential to be the selling points of the product for users and buyers. The MATRIX wheelchairs provide "what other wheelchairs do not" but at the same time, they are extremely "complex systems" to deal with. From the data gathered in our interviews, we believe that there is no training manual provided for the technicians and clinical assistants about seating patients in the complex wheelchair. Training forms an important aspect for any new product as it facilitates the ease of understanding and the acceptance of the product. In this case, when dealing with severely disabled patients, training for technicians and clinical assistants is vital to the well being and comfort of patients. Technicians are dealing with a lot of pressure of being able to seat the patient correctly and being trained effectively either by a manual or a training program can make their tasks more fruitful. Being able to seat patients correctly in wheelchairs can make the difference between life and death in some cases and it is our strong belief that a training manual will greatly ease the understanding of the MATRIX. Once the system can be understood effortlessly, there is a greater chance that the special seating community will readily accept the MATRIX special seating wheelchairs. Thus, based on the data gathered in our interviews and the assumption that there is no routine training program for the old MATRIX, we believe that this will be one of the selling points for the new MATRIX.

5.1.2 Quality control

We believe that another strong selling point for the MATRIX could be the implementation of quality control measures during the fitting process. From the data gathered in our interviews, there seemed to be no quality control problems with the technical design of the MATRIX seating system. In fact, most of our interview candidates seemed to appreciate the sturdy frame. However, they all believed that a great deal of mishaps related to the chair could be avoided if strong quality control measures were implemented during the fitting process of the patients. Fitting a patient to the wheelchair is the key to the overall improvement of the patient and the success of the rehabilitation program. At present, when the chairs are prescribed to patients there are no pre-determined standards that the chair has to pass through before being delivered to the patient. It is our firm belief that if quality standards can be prescribed during the fitting process for the new MATRIX they will prove to be the guidelines toward the success of this new product. The BES Department could also employ quality control managers during the fitting process whose primary task to ensure that the chairs are built to the highest quality standards. When a product conforms to quality standards, it immediately becomes attains a greater sales value in the minds of the users and influencers.

5.1.3 Support and Service

Finally, we believe that support and service could give the new MATRIX a stronger hold within the special seating community. Support and service refers to providing the buyer with repair and maintenance services for the wheelchair at any given time after the wheelchair has been prescribed. When a complex system like the MATRIX

has technical difficulties, the matter must be addressed as early as possible because most of the patients using this system spend about eight to ten hours in this wheelchair. Our interviewees revealed that the patients who were residing at the hospital had no problems with support and service as it was done in-house. The problem lay when the patient was released from the hospital and moved far away. Our study into this matter revealed that repair and maintenance of the MATRIX wheelchairs required a skilled technician to address the needs of the patient. The Biomedical Engineering Services department at present has already mastered repairing and maintaining MATRIX wheelchairs and it is our belief, that this could indeed be one of the reasons that people would choose the new MATRIX seating system over any other seating system.

The BES Department at the Royal Hospital for Neuro-disability is highly experienced in the area of special seating in regard to the MATRIX and other special seating systems. For in-house patients that opt for the MATRIX system, the department is able to provide training and support and service for the wheelchairs. Our improvement model will allow the department to focus their energies on tasks they are experts in. The strategic implications for the BES by implementing the module is that they will be providing the highest value to the customer as they are not only providing a superior, improved product but a service that complements the MATRIX special seating wheelchair. At present our study of other wheelchair seating services revealed that none of the competitors for the MATRIX provide quality control, training or support and service during the fitting process. Thus, if the BES Department approaches the market by presenting their new product along with the add-ons such as quality control, training,

support and service, we believe that this could be the answer to generating revenue for the department.

5.2 Market Share Data

In addition to providing the hospital with revenue generation possibilities we gathered data about the market size for special seating wheelchairs helped us create a tool that can be used to calculate the potential market sales for the MATRIX wheelchairs. By changing the variables of market penetration and acceptable MATRIX percentages, the BES Department can calculate the number of MATRIX special seats sold within one year. The tool can also be adapted to incorporate the number of special seats in England or any other area. The marketing information that we have compiled is a linear niche market assessment tool based on the size of the overall market, the size of the niche within the market and the penetration of a particular product. A niche market is defined as a smaller subset within a larger market.

Our recommendations to the BES Department are that a market exists for the MATRIX wheelchairs. This has been demonstrated by the previous MATRIX sales and the data gathered about the number of special seats in total. However, our data has not provided us with enough evidence to accurately assess the number of MATRIX wheelchairs that could be sold during the start-up period. Therefore, we stress upon the need for further investigation to be carried out using the data we have gathered as a starting point so that accurate market estimates can be obtained. To the best of our knowledge, we believe that the BES Department should investigate their target population in order to understand that market better. They will need to investigate their

capacity to produce the MATRIX special seating wheelchairs and determine the distribution channels in order to reach the target population effectively and quickly.

Thus, to conclude the information gathered from our interviews with the users and influencers of the MATRIX special seating system coupled with the market share data gathered from the research conducted has provided us with the knowledge and insight to make recommendations about the best marketing strategy for the MATRIX special seating system. With all this information compiled into a comprehensive report, we are providing the Biomedical Engineering Services department at the RHNd with a value proposition for the new MATRIX special seating wheelchairs.

The value of this project for the Royal Hospital for Neuro-disability is that it makes a connection between the skills and services that the hospital has to offer and the needs of special seating wheelchair users. This connection begins with addressing the needs of special seating wheelchair users who require experienced and skilled personnel along with a highly specialized product that is specifically curtailed to the individual user. Presently, the BES Department is equipped and qualified to fulfill the demands of the users within the hospital. By taking these skills along with a new improved product beyond the doors of the hospital, the BES Department can capture a significant market for the users along with generating revenue for the hospital. There is a potential market for the new MATRIX demonstrated by the research we have conducted. However, further investigation must be carried out to revalidate our results and add additional precision by

evaluating the locations and size of different markets for the MATRIX in England and possible competition and partnerships for this product.

The 3-point improvement module that we have provided for the RHNd provides them with a perspective on a promotional strategy for the commercialization of the MATRIX. We have highlighted the areas that we believe that the hospitals' strength lie in and believe that training, quality control and support and service should be the basis of their promotional package. We have also created a tool to predict the unit volume of MATRIX wheelchairs for the year 2001. Our calculation reflects the broad spectrum of the unit volume of the special seats that could be MATRIX dependant on the percentage of market penetration desired by the RHNd and thus provides them with a positioning strategy for the MATRIX wheelchairs. The higher the market penetration desired, the higher the promotional and marketing costs will be for the RHNd and we believe that they will be able to capture a greater percentage of the market for special seats. However, the lower the market penetration desired, lower costs for promotion and marketing will be incurred by the hospital as they will be responding to a smaller market segment. Thus, we have provided the RHNd with a valuable tool that provides them with a promotional and positioning strategy for the commercialization of the new MATRIX special seating wheelchairs.

As we have mentioned before, all our conclusions are only preliminary findings. The limitations in our data collection coupled with time constraints have not allowed us to thoroughly investigate every field that can be a successful venture for the MATRIX. We believe that the RHNd will still have to further research the potential market for the MATRIX based on more accurate data. They will also have to decide the percentage of

market penetration desired and based on that, they will have to adjust their promotional and positioning strategy. We believe that some problems that the BES could encounter during the launch of the new product are understaffing in the department. We believe that another problem area for the BES Department could be commitment from the upper management at the hospital. Finally, the only other problem area that we have identified for the BES Department is competition from other special seating wheelchair system. We do believe that if the department can overcome these hurdles, they can become leaders in the special seating community and generate revenue for the RHNd.

It is fortunate that no evidence has been revealed in this project that would lead us to believe that the new MATRIX not a worthwhile endeavour. Thus, with this project we provided the Biomedical Engineering Services department with evidence to justify their accomplishments so far and further direction on how to make the new MATRIX a success. We strongly believe that with support from the rest of the hospital and the continued dedication from the staff that every avenue of opportunity for the MATRIX special seating wheelchairs will be mapped.

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VIII. Appendices

7.1 APPENDIX A

Ms. XYZ
London, England.

Dear Ms. XYZ,

We are conducting a comprehensive study of the MATRIX wheelchair seating system for the Royal Hospital for Neuro-disability. This system has the potential to become a major aid in the special seating needs of the disabled. We believe that the MATRIX seating system is best evaluated through the opinions of decision makers involved in buying and selling the product. Because of your background in wheelchair design, we would appreciate the opportunity to discuss MATRIX and your decision-making criteria in wheelchair assessment. We are interviewing a few London experts in the field. Thus, your insight would be very important to us. We expect this interview to take no more than 10 to 15 minutes and would be glad to schedule it at an equally suitable time for you in person or over the telephone. Your responses will contribute to the MATRIX as a product and help give better services to those with special seating needs.

By participating in the interview you will help us better develop the product. You will be able to benefit from this by being able to provide a higher quality product for your clientele and better serve the needs of the Neuro-disabled. We will be contacting you after the bank holiday on May 28, 2001 to arrange a mutually convenient time for an interview. If you have any further questions, please do not hesitate to contact us at the Royal Hospital for Neuro-disability at 0208 780 4500 Extn 5132. For your information, we will be off-site on May 25, 2001. Once again, we greatly appreciate your participation in this important and informative research project.

Sincerely,

David DeRoche Jeffrey Kibler Janaki Kirloskar Matthew McCue

Biomedical Engineering Services
Royal Hospital for Neuro-disability

7.2 APPENDIX B

Interview Questionnaire

Contact Name:
Position:
Phone Interview:
Time for Interview:

1: What roles do you play involving special seating wheelchairs?

2: As you have prior experience with the MATRIX, what do you believe are the strengths and weaknesses of the old MATRIX seating system?

3: What are potential solutions to the problems you have mentioned?

4: Does the design for the new MATRIX incorporate these solutions?

5: How effective has the MATRIX been in solving problems before its predecessors have been?

6: How does the MATRIX wheelchairs compare in cost-effectiveness and fulfilling the users' needs as compared with other products?

7: If we need to further contact you, how do we do it?

7.3 APPENDIX C

Mr. XYZ,
England.

Dear Mr. XYZ,

This letter is in regard to our phone call this morning. We would like to thank you for helping us obtain information about the unit volume of special seating wheelchairs issued in England. This information is extremely valuable to our research project. We are conducting a comprehensive study of the MATRIX wheelchair seating system for the Royal Hospital for Neuro-disability. This system has the potential to become a major aid in the special seating needs of the disabled. Your response will contribute to the MATRIX as a product and help give better services to those with special seating needs. Our contact information at the Royal Hospital for Neuro-disability is given below:

Janaki Kirloskar
C/o Biomedical Engineering Services
Royal Hospital for Neuro-disability
West Hill, Putney
SW15 3SW

Phone: 0208 780 4500 extn. 5132
Fax: 0208 780 4501

Once again, we thank you for your time and effort and look forward to receiving the information from you as soon as possible.

Sincerely,

David DeRoche Jeffrey Kibler Janaki Kirloskar Matthew McCue

Biomedical Engineering Services
Royal Hospital for Neuro-disability

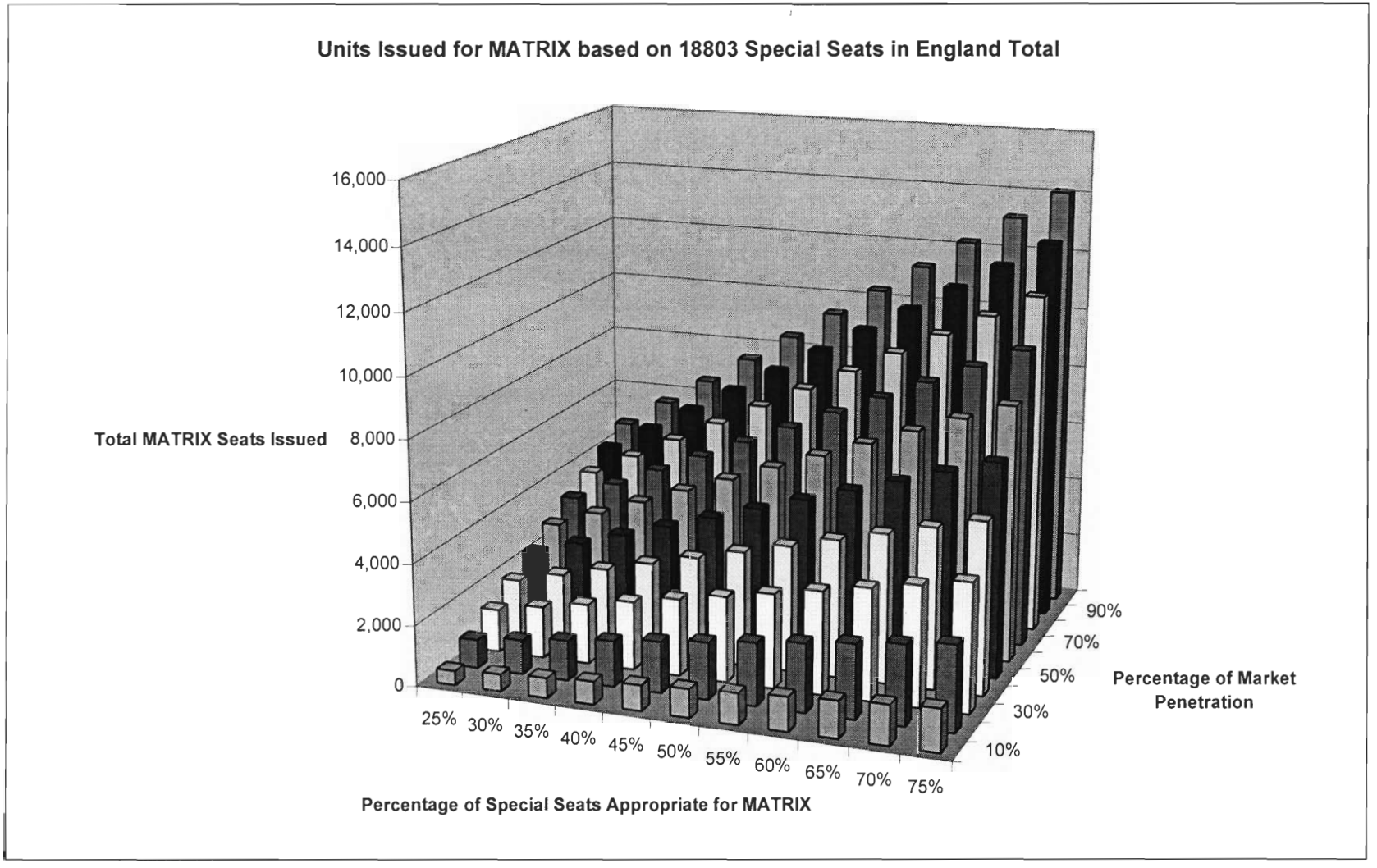
7.4 APPENDIX D

			UnitsSold									
			Growth		Total number of wheelchairs in England in 96-97							1956000
	Actual	Year94-95	14,616									
	Actual	Year95-96	14,759		Dr. Cousins's estimate of how many wheelchairs out of total in England could be matrix							
	Actual	Year96-97	15,748									0.005
	Projected	Year97-98	16,812.50									
	Projected	Year98-99	17,451		Proportion of total wheelchairs to special seating wheelchairs							0.008051
	Projected	Year99-00	18114.62									
	Projected	Year00-01	18,803									
					Fraction of special seating chairs appropriate for MATRIX							0.621031
	Growth Rate		3.8%			Calculated from above data						
Percentage of Market Penetration				Range special seating wheelchairs that could use matrix (25%-75%)								
	18,803	25%	30%	35%	40%	45%	50%	55%	60%	65%	70%	75%
10%	1,880	470	564	658	752	846	940	1,034	1,128	1,222	1,316	1,410
20%	3,761	940	1,128	1,316	1,504	1,692	1,880	2,068	2,256	2,444	2,632	2,820
30%	5,641	1,410	1,692	1,974	2,256	2,538	2,820	3,102	3,385	3,667	3,949	4,231
40%	7,521	1,880	2,256	2,632	3,008	3,385	3,761	4,137	4,513	4,889	5,265	5,641
50%	9,402	2,350	2,820	3,291	3,761	4,231	4,701	5,171	5,641	6,111	6,581	7,051
60%	11,282	2,820	3,385	3,949	4,513	5,077	5,641	6,205	6,769	7,333	7,897	8,461
70%	13,162	3,291	3,949	4,607	5,265	5,923	6,581	7,239	7,897	8,555	9,213	9,872
80%	15,042	3,761	4,513	5,265	6,017	6,769	7,521	8,273	9,025	9,778	10,530	11,282
90%	16,923	4,231	5,077	5,923	6,769	7,615	8,461	9,307	10,154	11,000	11,846	12,692
100%	18,803	4,701	5,641	6,581	7,521	8,461	9,402	10,342	11,282	12,222	13,162	14,102

7.5 APPENDIX E

Stainless Steel						
		Unit Cost		Total Costs		Difference
	Qty	8 Cavity	16 Cavity	8 Cavity	16 Cavity	
4-ball	275	£0.03377	£0.02587	£9.29	£7.11	£2.17
Trimplate	624	£0.01787	£0.01278	£11.15	£7.97	£3.18
Flangeplate	624	£0.03100	£0.03100	£19.34	£19.34	£0.00
Clamp Plate	624	£0.01600	£0.01600	£9.98	£9.98	£0.00
Screw Insert	312	£0.08620	£0.08620	£26.89	£26.89	£0.00
Screws	312	£0.02500	£0.02500	£7.80	£7.80	£0.00
Clear Balls	74	£0.10000	£0.10000	£7.40	£7.40	£0.00
Total Assembly				£10.00	£10.00	
				£101.86	£96.51	£5.35
Spring Steel						
		Unit Cost		Total Costs		Difference
		8 Cavity	16 Cavity	8 Cavity	16 Cavity	
4-ball	275	£0.03377	£0.02587	£9.29	£7.11	£2.17
Trimplate	624	£0.01787	£0.01278	£11.15	£7.97	£3.18
Flangeplate	624	£0.02600	£0.02600	£16.22	£16.22	£0.00
Clamp Plate	312	£0.01600	£0.01600	£4.99	£4.99	£0.00
Screw Insert	312	£0.02180	£0.02180	£6.80	£6.80	£0.00
Screws	312	£0.02500	£0.02500	£7.80	£7.80	£0.00
Clear Balls	74	£0.10000	£0.10000	£7.40	£7.40	£0.00
Total Assembly				£10.00	£10.00	
				£73.66	£68.31	£5.35
				Total Difference		
				£28.20	£28.20	0

7.5 APPENDIX F



7.6 APPENDIX G

	Profit per Unit		£200.00
	Fraction of Market		0.05
	Fraction of Acceptable use		0.33
	Size of Market		18803
	Profit per year		£62,050
Start up cost	Years to Recoup Startup		
£90,000	1 5/12		
£95,000	1 6/12		
£100,000	1 7/12		
£105,000	1 8/12		
£110,000	1 9/12		
£115,000	1 10/12		
£120,000	1 11/12		
£125,000	2		
£130,000	2 1/12		
£135,000	2 2/12		
£140,000	2 3/12		
£145,000	2 4/12		
£150,000	2 5/12		
£155,000	2 6/12		
£160,000	2 7/12		