INCLUSIVE ADVENTURE BY DESIGN: THE DEVELOPMENT OF OPPORTUNITIES IN OUTDOOR SPORT FOR DISABLED PEOPLE THROUGH CO-ORDINATED PEOPLE CENTRED RESEARCH AND DEVELOPMENT IN DESIGN AND COACHING

A thesis submitted for the degree of Doctor of Philosophy

By

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I. Abstract

Structured to help readers from a range of disciplines, the thesis looks at the creation of opportunities for participation in adventure sport, specifically the development of a postural support for intermediate level performers with spinal cord injury in sea kayaking. The research has shown that it is possible to increase the performance level of disabled athletes in paddle sport through the development of appropriate adaptive equipment, which in turn promotes inclusion and the broadening of opportunities.

This research project takes place against a backdrop of national events and developments; notably, changes in UK legislation to do with disability access (DDA 1995), and developments in legislation to do with outdoor safety. The research also takes place against a backdrop of national campaigns, such as the 'Campaign for Adventure', and an increasing number of drives to make the UK's population more active. The broad-based multidisciplinary approach is in line with reported priorities in international disability sport research, while encompassing paddlesport specific criteria.

The research takes the approach of design research to develop the product. Initially the reported studies evaluate the design process utilising desk-based research. They then proceed to utilise design methodology in field-based short and longer expedition settings. The design process utilises existing user-centred staged design approaches to explore methods for wider application.

The findings reveal that the development of opportunities in adventure sport with disabled people involves engaging with a social mess. The action of problem definition and resolution can be termed in this paradigm as a wicked problem, being that is does not have one clear solution. The information

needing to be exchanged in the problem resolution can be considered as sticky, being that the research process takes place in a specialised arena characterised by sparse resources and with a multidisciplinary team.

The research has informed the creation of twelve tools to support those practitioners involved in this area. Used from the bottom up or top down, they provide a common language between the participant, coach, therapist and researcher to help educate and inspire each person to understand the true nature of the problem, improve the shared understanding within the team, and thereby reducing the stickiness of the information. The effect on the development of new equipment is to improve focus and user participation, so making it easier to work within the social mess.

A new postural support was designed for use by intermediate level sea kayakers with spinal cord injury, the design of which is given in study 9, which is evaluated in study 10.

The study suggests that future work in this area should focus on the co-ordination of sport science support, further exploration of the link between design research and social change, explore the validity of the tools across a broader population, and further develop the design so that the new equipment can be of benefit to the broader population.

II. Acknowledgements

There are a great many people to thank for helping make this research happen. Firstly I would like to thank all the participants of the studies, expeditions and fieldwork who have helped to make sure that the work is both people-centred and real.

Thank you to funders who have helped by supporting pragmatic work which has framed the deeper thinking of the PhD; Marion, Charlie, all at Search, those at the National Lottery as well as supporters of Interventure, such as the Royal Geographical Society (with IBG), who have helped to inform and develop the fieldwork element of the PhD. In addition there are many people from business funding agencies that have helped take the work into the real world; in particular, thank you to Doug from Fusion and Jim et al at Scotland UnLtd.

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On a personal level my family, mum and dad, Sara and Ronnie have been real supporters, helping ensure that I continue to plod on with the project even when funding, time and support have been scarce. Here I must also mention Bill from up the road, who is great with grammar!

Finally there is a collection of people who have inspired me; Prof. Wolf, Prof. Sutherland, and Nigel and Shane Winser at the Royal Geographical Society (with IBG), all of whom in their own way have encouraged me to keep going and added a challenging question or deadline when I have been slacking. There are more people who have helped in so many different ways: thank you to you all.

Suresh

P.s. Yes I know that I am the last triplet to get a PhD.

III. Preface

Introduction to Preface - Researcher's Personal Perspective and Background

As a researcher I acknowledge my part in the research process and the way in which my world view and ethical and educational standpoint may affect the outcome of even the most rigorous research. The following section seeks to provide the reader with a framework for understanding my personal standpoint as a researcher, in essence my research credo. The final part of this section goes on to outline my personal background and its relevance to the research focus. This discussion is considered in Chapter six, Methodology.

My Beliefs

As a designer, educationalist and coach, my aim is to promote equality, social understanding and environmental awareness on all levels. My design work in many ways is a three-dimensional representation of my aspirations for equality. The thrust of my published material is to promote understanding, to ensure that my practical hopes and aspirations for others are understood and to ensure that I am not the sole gatekeeper of the information and research of which I am fortunate to be part. My work on inclusive expeditions aims to ensure that all people are able to access this research process. I see this as essential to our democracy in the twenty-first century. From my perspective, promoting the understanding of the needs of our environment is vital to the continued health and welfare of our planet.

How I Work

I thrive on sharing a belief that in a good team the whole is greater than the sum of the individual parts: two plus two will always make five. I enjoy a flexible approach to work, actively seeking partnerships which bring a multi-disciplined approach to problem solving. As with the equality issues which are core to my work and credo, I believe that a team should be involved in all of the decisions which shape both the outcome of a project as well as the working process.

My Motivation

I am motivated by sharing and creating new opportunities and enjoy the silence which empowering people brings. I have been fortunate to gain a wealth of experiences in the outdoor adventure and expedition environments both in the UK and abroad. I am driven by my own good fortune, which I seek to share in a range of practical ways without the discomfort of discrimination.

Personal Background

I was born in 1970 in north London, of mixed race, sharing both English and Indian cultures. My memories of my early years are immersed in a struggle for survival in an urban society which did not quite have a place for Anglo-Indian culture. The early 1970s was a time before any substantial Indian identity was established in the UK. I can remember finding ways into Chinese and Rasta perspectives and ideologies, yet due to my own family construct, the route to what I could loosely define as Anglo-Asian-ness was closed. Without language or story I felt as if I stuck out like a sore thumb, yet without the hand. This feeling of personal disempowerment lasted for many years. It was not until I found my life taking me to the mountains that, as a teenager, I discovered a perspective which has held true for me to this day.

I feel that coming to terms with my early experiences, and my racial identity and context, has been one of the greatest challenges that I have ever faced. In retrospect I now understand that this is not an unusual task. All of us have to deal with whatever cards we are dealt during childhood. However, I also recognise that I have been shaped by those early experiences and feel that much of my search for equality has been driven by my early challenges. My drive, anger and reaction to early childhood racism, attacks and beatings became channelled into my work. I feel fortunate to have found an outlet which is largely positive and yet removed from the struggle which I knew back in the 1970s and 1980s of north London.

I have found that my understanding of disempowerment, and my experiences of overcoming what were minor but personally significant injuries, has given me cause to challenge my own social and physical perspectives on the meaningful involvement of minority groups in sport and society. Ultimately I believe that my journey has brought me to feel that with appropriate design it is possible to inspire and initiate meaningful and long lasting social change.

During my professional career I have strived to mix my practical and research objectives with practical coaching. It is this range of activities which I feel has been useful in developing project solutions and opportunities at the Adventure Designs Project, and then latterly through the foundation and day to day running of Equal Adventure (EA). EA's activities draw on the philosophical dilemmas considered in this thesis, providing a driver for not-for-profit activities in product development, training and information provision.

Experiential Learning in Adventure Sport and Opportunity Development that has Influenced My Approach to Research

During my involvement in and coordination of a range of design and development projects (see Appendix A), I have developed my understanding of disability, sport and design. This has created a platform for this PhD.

For me, the most relevant aspect of my professional role has been the management of a number of young researchers on various projects (see Appendix A). I have observed these young researchers settling into projects. Their struggles have been to grasp the key issues involved with the generation and creation of solutions, which are either 'barrier free', or intended to satisfy the specific requirements of particular groups of people with disabilities. The following issues seem to be key during the training and settling in period:

- A functional understanding of the needs of the users
- Comfort and ease with specific positive language associated with disability, society and specific medical conditions
- A broad understanding of what is required to take a product to market.

The pattern of development which I have observed has been one of many researchers initially concentrating on medical requirements and contra-indications for use. They have been 'scared' of disability, a reaction echoed by manufacturers, insurers and other design-process stakeholders. Many have required additional support and encouragement from medical and clinical staff to further ratify any people-centred research.

These issues above are reflected by my own search for an appropriate hypothesis, and in the multi-disciplinary approach to this research.

Research as a Method for Developing an In-depth Understanding of Inclusive Design

This PhD research project has provided a way of deepening my personal understanding of disability. The project has provided a structure for identifying how disability or impairment can be understood in a pragmatic and functional manner. Much of this has been through seeking to better understand the emerging models of disability. By far the most personally useful strand has been the interaction with individuals from other areas outside design. Gaining understanding of concepts from rehabilitation, coaching and education has enabled me to understand disability in a purely functional manner, removing much of the requirement for highly technical language.

Developing this functional approach has helped me develop other pragmatic outcomes outside the scope of this PhD, such as disability awareness training for sports instructors, teachers, expedition organisations and outdoor providers.

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VII. Abbreviations

AALA – Adventure Activities Licensing Authority

APA – Adaptive Physical Activity

BCU – British Canoe Union

DDA – Disability Discrimination Act

IFI – Inclusive Fitness Initiative

ICF – International Classification of Function

RGS (with IBG) – Royal Geographical Society with Institute for British Geographers

SCA – Scottish Canoe Association

SCI – Spinal Cord Injury

UTI – Urinary Tract Infection

WHO – World Health Organisation

1.

Chapter 1

The Culture and Sociology of Disability and Its Interaction with Sport and Outdoor Adventure

1.0. Aiding Interdisciplinary Research

This section justifies the organisation and structure of the thesis to assist the reader to access the thesis. This thesis can be seen as an aid to interdisciplinary collaboration, consequently, the thesis is structured to facilitate access by practitioners and researchers from a number of paradigms. Overall the thesis can be considered in two halves - chapters one to six which provides a review of literature and outlines the methodology for the research, and chapter seven providing the conclusions. The research data is given in Appendix F.

The literature review consists of chapter one which takes a sociological perspective, chapter two which considers rationale for the research from the ethical point of view and chapter three, which reviews current practice in inclusive sea kayaking. Chapter four is pivotal to the thesis and allows the reader to access a snap shot of the key themes from the literature review and presents the hypothesis and research objectives. The methodology is presented in two halves again to allow the reader access to fieldwork considerations in chapter five independently to the methodological perspective given in chapter six. Chapter seven provides the results from the ten studies which are complimented by associated appendices which provide logistical and background information to each study. Chapter seven is designed to allow the reader to access the conclusions to each of the studies and the context to the conclusions to the research.

A suggestion for a lightweight read would be chapters two, four and seven. Those requiring a detailed summary of the research may consider reviewing chapters two and four to gain an overview of the key themes. A selection of either chapter five or six could then be made depending on the reader’s interest in either fieldwork protocols or methodology respectively. The reader could then conclude with a detailed review of chapter seven.

1.1. Summary

This section summarises the research providing an outline of each of the chapters. The research starts with a review of literature, Chapter one, from a range of paradigms including; the sociology of disability, disability sport, inclusive design. It also places the research theoretically against key issues in sports development, coaching, and outdoor practice including expeditions and fieldwork. Chapter two looks at the importance of the research against other societal needs, considering the ethical standpoint for this research on social development and equality through design. In Chapter three, the current state of play is discussed with regard to specialist seating systems for disabled people.

The hypothesis, research aim and objectives are outlined in chapter four. Chapter five considers the issues of fieldwork safety, including both physical and emotional safety, as well as issues to do with inclusive logistical practice and teamwork for the research team in the field.

The methodology for the research is outlined in Chapter six, which commences with a summary of the problems facing designers when searching for inclusive design methodologies. The chapter moves on to review a number of research approaches, which form a toolbox for the design research. Following this there is a summary plan of the research, followed by detailed plans of all ten studies and their evaluations. Chapter six concludes with a detailed description of the research methodology. The methodology utilises a people-centred action research process. The foundations for the research approach are from social research, facilitation or development training and performance coaching. The research utilises a functional model of disability as the common language, and suggests a model of opportunity development in order to provide a metric of success for the socially minded inclusive designer.

Chapter seven concludes the research, in relation to the success of both the design outcome and the development of methodologies for the inclusive sports equipment designer. It also provides a summary of the results and discusses themes for future work. It is followed by the Appendices, which contain the full data and fieldwork reports.

The ten studies and their evaluations are outlined in Appendix F. Each case study is presented, in turn with logistical considerations presented in the appendices so that the reader is able to access the data. The main study focuses on an iterative product design and development process, which brings together feedback from a user group of sea kayakers with spinal cord injury. The fieldwork phase of the research consists of a review of preliminary studies undertaken on a range of international expeditions, many of which were supported by the Royal Geographical Society (with IBG). The main study is framed against these preliminary studies. Additional preliminary field data is drawn upon from field visits to the Paralympic Scientific Congress, and to the Paralympic Games in Sydney 2000. It also draws from the author's involvement in the Inclusive Fitness Initiative. The final design is evaluated against a range of criteria taken from all sections of the work. The key sections are; rationale, inclusive design criteria, usability by the user group, usability by the market identified in the functional model of disability, usability in the proposed environment. Additionally the final product is seen against the potential commercial viability when placed on the market, to help create new opportunities.

The stylistic emphasis of the PhD is to use the standard academic practice of critical analysis, balanced with structured reflection based upon interactions with the key fieldwork elements and with pragmatic approaches. Interactions with the outdoor and expedition worlds has been driven by annual presentations at national conferences (1996-2009), such as the National Institute for Outdoor Learning Conference and Explore, the annual expeditions and fieldwork conference run by the Royal Geographical Society (with IBG). The research has also formed the philosophical cornerstone of a charity, Equal Adventure, which is now placed to tackle the broader problem of creating resources for inclusive adventure.

Elements of the thesis have been submitted for peer review publication at conferences such as Cambridge Workshop of Universal Access and Assistive Technology, 2006 (herein referred to as CWUAAT), Include 2005 at the Royal College of Art (herein referred to as the RCA), and the International Sports Engineering Association (ISEA) conference, 2004.

Philosophically, the work asks if design is simply learning for both the researcher and the athlete or participant, and poses questions for the design community about its vision of humanity. For the expedition and fieldwork community, the work suggests a methodology which can be used for people-centred fieldwork studies. For the kayaking world, the research presents a new canvas for exploration at sea by disabled people, through the presentation of a modular design. For kayak coaches, the thesis brings a deeper understanding of how performance is modified as a result of impairment or disability, by asking a fundamental question about sports performance: ‘Where does the equipment stop, and coaching and performance start?’

This study has shown the link between the coach, performer and the designer. It has demonstrated the use of a new set of tools for designers when considering inclusive sports equipment development, which draws on the work of the World Health Organisation (WHO) and the International Paralympic Committee (IPC). The study has illustrated a link between coaching and outdoor leadership issues and occupational models of performance, creating models which can be used to train sports coaches and inform designers, which help to ensure that all agents in the development process are better able to cater for the needs of disabled people. The study has also helped to define a model of interrelationships between athletes and supporting agents, such as designers and sports scientists, to promote the best use of limited finance within this area of human performance.

Introduction to the Literature Review

The aim of the remainder of this chapter is to outline some of the key concepts for the research within the scope of disability, sport and design, and their interaction based on a review of the current literature. In the second section of this chapter, I look at design and design inclusion, and relate design to the sphere of outdoor activity and expeditions.

Definitions of disability and social perspectives on inclusion are identified in section 1.1. Section 1.2 considers disability from a historical perspective, from the pre-history of disability in Europe. The demography and epidemiology of disability help to identify the scale of the population to which this research refers. Models of disability are considered to provide a socio-political and cultural framework from which to consider discrimination and anti-discrimination legislation in the UK surrounding disability.

Section 1.3 outlines the background to sport and disability sport, its structure and classification, and defining sport and physical activity. The nature of sports participation and performance is considered to introduce metrics for success for the sports equipment designer. Stakeholders and decision makers in sport are identified to structure the engagement of people in the design process.

Section 1.4 maps the structure and history of disability sport in the UK, identifying support structures and models of participation for disabled athletes. The section considers the performance expectations of disabled athletes and the self image of disabled people.

Adaptive Physical Activity (APA) is discussed in 1.5 and the priorities for research in this field are discussed in 1.6. Section 1.7 considers the classification of disabled athletes from a functional perspective.

Section 1.8 considers design in terms of its interaction with society, as well as its creative process. Design research is also considered. The section concludes with an exploration of the purpose of design in terms of defining the focus of the design project.

Section 1.9 introduces Inclusive Design, identifying its external driver in the aging western trans-generational society. Current approaches to design for disability and models for inclusive design are outlined. The section finishes with an overview of current standards in Inclusive Design Management.

Section 1.10 considers the relationship between the designer, athlete and sports coach, and goes on to identify the ideal test environment in Section 1.11. Problems with inclusive design are explored before an exploration of the start point for sports equipment design.

The final section of this chapter, 1.12, considers the relationship between the outdoors and expeditions. Introducing expeditions and field work, the section concludes with a look at the relationship between design and expeditions from a historical perspective.

1.2. Definitions of Disability

This section aims to provide a position statement to aid the reader in the remainder of the thesis. Additional definitions surrounding sport, physical activity, fieldwork and risk are given in context throughout the thesis.

APA Quarterly reports on sport and rehabilitation issues for people with a disability. The editors use a ‘people-first’ term of reference when talking about disability, i.e. people with a disability. However, according to Barnes (1991), the ‘people-first’ methodology does not take into account the social consequences of disability, and Barnes prefers to use ‘disabled people’ as the style of reference. With the dichotomy of approaches to the language of disability and the feeling that the basic language is a representation of a human rights issue, it is essential to consider how the varying standpoints affect both the language and the content of the initial and subsequent sections of this research.

For the purpose of this thesis I propose a model of language which presents disabled people as active or in control, regardless of their social or technical context. When speaking in a technical context, I will use the methodology adopted by Adapted Physical Activity (APA) Quarterly (Sherill 1997).

In a social context I will use the methodology favoured by Barnes, as I feel that this provides a linguistic mechanism which enables us to value the person regardless of the context.

This positive and flexible approach allows one to focus on the real design or development issues rather than stumbling over the discussions concerning the politics of language, as illustrated by Morris (1989):

> *'We can insist that society disables us by its prejudice and by its failure to meet the needs created by disability, but to deny the personal experience, is in the end to collude with our oppression.'*

There is no clear view of a definition of disability. Models of disability have developed which in themselves change the nature of the way in which disability is defined. Finkelstein and French (1993) suggest that there is no clear definition of the experience of disability from a psychological perspective. Finkelstein and French (1993, p.28) suggest the following:

> *'Impairment is the lack of part or all of a limb, or having a defective limb, organ or mechanism of the body.*
>
> *Disability, is the loss or limitation of opportunities that prevents people who have impairments from taking part in the normal life of the community on an equal level with others due to physical and social barriers.'*

This is different to the World Health Organisation (WHO) definition, which has taken a more functional approach to disability as a result of the development of the functional model of disability. WHO (2001, p.4) states:

‘International Classification of Function (ICF) has moved away from being a “consequences of disease” classification (1980 version) to become a “components of health” classification. “Components of health” identifies the constituents of health, whereas “consequences” focuses on the impacts of diseases or other health conditions that may follow as a result. Thus, ICF takes a neutral stand with regard to etiology so that researchers can draw causal inferences using appropriate scientific methods.’

I prefer WHO’s (2001) perspective and see disability in a neutral context, as a designer seeking to solve functional problems, which in turn may have an impact on the practical access of an individual to an opportunity or social function.

1.2.1. Social Perspectives on Inclusion

In this section I suggest that one of the key values for society in the UK is inclusion, and that the impact of negative actions can have an effect on individuals within that society as well as society as a whole. We are reminded of this in the Commission for Racial Equality’s definition of a racist incident. The Commission, as cited by Morris (1999), states:

‘…A racial incident is defined as any incident which is perceived to be racist by the victim or any other person.’

It is this dualistic perspective which makes it necessary to consider disability in its historical and broader context within society. This perspective is reflected in the evolution of models of disability as discussed later in this chapter. I suggest therefore that it is possible to see inclusion from a range of perspectives which are dependent on the individual.

1.3. Disability

1.3.1. The Pre- History of Disability in Europe

Thomas (2001) introduces the concept of negative attitudes towards disabled people as a sociological factor in a historical context. He writes (2001, p1):

> *'According to Barnes (1997) the Greeks had a profound effect on the culture and values of western civilisation, and therefore on attitudes toward disability. There was no place for women, non-Greeks and the physically or intellectually inferior, rather there was an obsession with bodily perfection. Children that the Greeks or Romans from 500BC – 400AD considered to be disabled, were killed. The early Christians were compassionate to all but those with mental illness who were considered as sinful and were often killed as a result. In the 16th and 17th century deaf people were deemed godly and superior to the hearing. It was not until the 18th Century and the emergence of welfare and caring social policies, that disabled people were treated with more dignity. However, the ideology of caring in the late 18 and early 19 Century marginalised disabled people, illustrated by the proliferation of segregated institutions such as special schools and asylums for the mentally ill and the 'handicapped'. Although by the 20 Century, in recognition of the significant financial burden that war injured patients placed on government welfare service suggested that stringent criteria to diagnose disability were introduced.'*

It is from this historical perspective that we see disability in its modern context. This is illustrated by studies, such as those within Mastro et al (1996), which consider the attitudes of non-disabled people to disabled people. Lemon (1973, p.34) states:

> *'An attitude is an acquired behavioral disposition or an emotion of action towards a person, a place or a thing, or an abstract concept.'*

Attitudes have been measured between social groups in society. A meta analysis of a range of studies using Bogardus' measure of social distance, (where social distance is the degree of sympathetic understanding that exists between persons), suggests that there is a hierarchy of preference which describes the social relationships between disabled and non disabled people. Mastro et al (1996, p.198) notes:

> *'The authors reported a hierarchy of preferences of non-disabled persons towards persons in various disability categories. The findings across these studies were very similar, revealing an extremely stable hierarchy of preference in American society that underlines stereotypical thoughts and behaviours.'*

We can therefore see that there are parallels between the way in which disability is seen in modern day society and the way in which disability has been seen historically, or that social preferences still exist within society as well as within the disability community itself. This has relevance to the research, as it provides a backdrop for how the findings of this research may be seen, as well as illustrating the range of potential attitudes for stakeholders within the research.

1.3.2. Demography and Epidemiology of Disability

In this section I review some of the demographic data concerning the prevalence of disability in the UK. Oliver (1998) suggests that this is a futile activity and that it is necessary to focus on the cause of disabling environments rather than the prevalence of disability. Oliver (1998, p.64) states:

> *'If disability is socially caused, then changes in social organization (which happen all the time) may increase or decrease the numbers of disabled people in society at any one time. […] the counting of numbers of disabled people is still a waste of time. A major reason for this is that no accurate data have ever been produced.'*

However from a functional perspective, even the estimates provide a start-point for further development and appropriate use of resources. The Prime Minister's Strategy Unit (2005) suggests that in 2004 there were an estimated 59.8 million people in the UK with a growth rate of 0.3% between mid 1991 to mid 2003.

Using the widest definitions, the population of disabled people is large; about 11 million adults and 770,000 children in the UK (see Figure 1). This equates to more than one in five adults, and around one in twenty children (Prime Minister's Strategy Unit 2005).

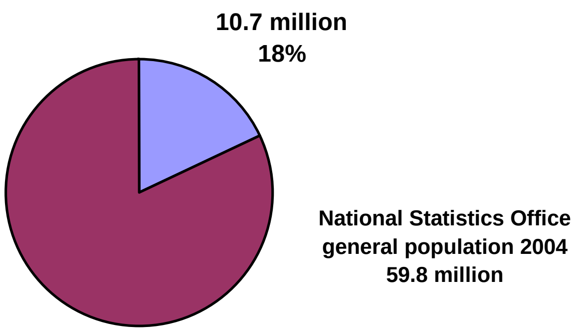


*Figure **1** Estimated population of disabled people in the UK in 2004 (NHS 2001)*

The Health Survey for England (NHS 2001), estimated that 18% of men and women aged 16 and over have one or more of five types of disability (locomotor, personal care, sight, hearing and communication). 5% of adults are reported to have a serious disability. From the estimation it is likely that just over half (55%) of men and women with any disability have one disability, a third have two disabilities and about a tenth have three or more disabilities.

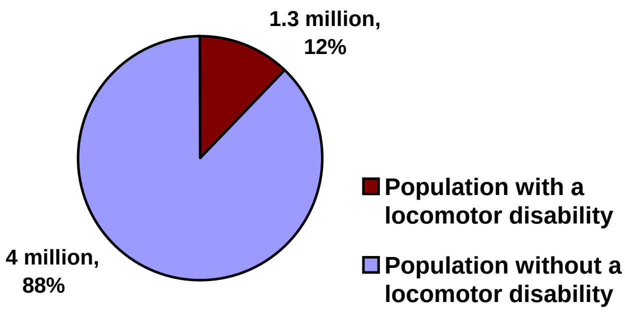


Figure **2** *Estimated population of disabled people in the UK in 2004 with a locomotor disability (NHS 2001)*

The most commonly reported type of disability was locomotor disability. 12% of men and 14% of women reported having locomotor disability as shown in Figure 2.

The population with a locomotor disability in the UK consists largely of individuals with a single disability, which could be caused by a range of impairments. Figure 3 shows that 46% of people with a locomotor disability have a number of other disabilities.

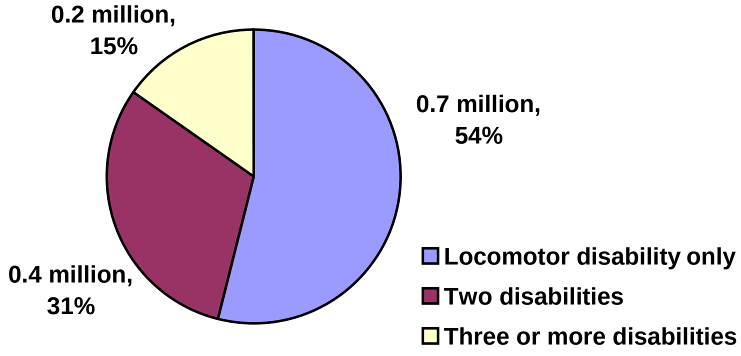


*Figure **3** Estimates within the locomotor disability group of two or more other disabilities*

1.3.3. An Overview of the Models of Disability

Pfeiffer (2002) discusses Models of disability, suggesting that models are used to analyse and measure variables in order to generate hypotheses concerning the nature of disability.

Language and terminology concepts provide an insight into the common societal perceptions of disability and therefore the views of disabled people as seen by society. Disability researchers state that the way in which disability is described has a real effect on the experience of disabled people. Finkelstein (1993, p.13) stated:

> *'Regardless of personal wishes therefore, being labeled as disabled is a fact of life for all disabled people in the contemporary world. As long as there is no possibility of gaining access to services or social welfare benefits without surrendering to the label 'disabled' there is no possibility of maintaining that an individual or group is not disabled. The use of equipment such as wheelchairs, or forms of communication, such as brail signing, not used by normal people, only confirms the user as a disabled person.'*

As a designer, I find this a compelling reason to discover the foundation of the relationship between disability and its representation to and in society. Developing a greater understanding of this relationship will ensure that the process of design provides a positive and liberating experience rather than further forming shackles to the expression of an individual's experience, regardless of how well meant or how functional.

Over the past decades there has been a distinct movement away from what came to be commonly known as the medical model of disability. The medical model (WHO 2001) was originally devised by clinical staff and was used to define a person as a condition. The model has a number of drawbacks, especially when considered against a framework of social change. Within this model the individual is not valued and the need is to cure the disability, the consequence of which is to lead to an exclusive methodology, which oppresses disabled people through a process of assumption and stereotyping. Subsequent social models have moved away from this medical standpoint to include the effect of the environment on the experience of the individual.

The social model (Crow 1996) is based on the assumption that the individual is valued and that disability is something which is created by society. The model has supported a worldwide movement, which in the UK has led to the development of the Disability Discrimination Act (HMSO 1995).

With the shift in societal perspectives concerning disability, I feel that there is a need to look at the conceptual framework of disability in a more functional light. The need is not to give up the fight for equal rights and equality of opportunity, but to send out a clear message that the individual is to be valued in every way regardless of impairment, and that the key to true and meaningful social inclusion is to send out a simple clear message, which seeks to educate, inform and provoke thought. As Finkelstein and French (1993, p.33) stated:

> *'There is a dynamic relationship between impairment and disability which we believe provides the starting-point for the construction of a new approach to the psychology of disability.'*

There is a growing requirement for the complex and sometimes daunting issues concerned with disability to be expanded upon in a manner which facilitates a greater level of understanding above and beyond the social model. I therefore propose that the social model is expanded upon to form a functional model of disability. According to Crow (1996, p.55):

> *'Acknowledging the relevance of impairment is essential to ensuring that people are knowledgeable about their own circumstances.'*

This has been recognized from a developmental standpoint by WHO (2002), which noted the importance of addressing the social and physical environment to improve function and performance.

The use of a functional model is also supported by the Disability Rights Commission (DRC 2006), which suggests that organisations develop access statements as a way of communicating their compliance with UK Disability Discrimination Legislation.

The functional model has been adopted by WHO with the generation of the International Classification of Functioning, Disability and Health (ICF, WHO 2001). The ICF (WHO 2001) is a classification of health and health domains that describes how people live with their health condition, including body structure, body function, activity and participation, classifying according to body, individual and societal (including environmental) perspectives.

It is the development of international perspectives and models of disability which has helped facilitate the development of national legislative structures, such as the 1995 Disability Discrimination Act (1995), in the UK. This is illustrated in the introduction to WHO's functional classification system (WHO 2001), which states that the ICF can be used to aid the implementation of international human rights.

In the functional model, the individual is still valued and individual requirements are decided upon through a process of user-led consultation, thus placing the individual in the centre of the development cycle. From this positive human-centred standpoint, it is then possible to look at the functional profile of the individual in order to develop a greater level of understanding about the individual. On a collective basis, the functional model allows those involved in planning provision of opportunities or design, to build a level of understanding about the true nature of the human continuum. With a greater level of understanding it is then possible to look for patterns of function in order to adopt a barrier-free approach to the provision of services, opportunities or equipment.

In sport, the functional model has been used to promote fair competition between people with differing disabilities (Meaden 1991). Meaden's research considered the way in which athletes were classified into competition categories in order to provide a structure for fair and equitable performance structures. By segmenting the body, the profile system provides a model of human performance. It creates a platform for issues to be discussed at face value and the model makes it possible to compare the movement capabilities of individuals with similar performance profiles.

1.3.4. The Culture and Sociology of Disability

Society is made up of a range of groups of individuals with a range of needs, perspectives and characteristics. Hylton and Totten (2001) suggest that the construct of society can be seen from four perspectives; Functionalist, Neo-Marxist, Feminist, and Post Modernist. I see society from a functional perspective. According to Hylton and Totten (2001, p.50):

> *'Society is based on a broad agreement (consensus). This consensus reflects a balance between different interests. The 'social system' regulates the smooth flow of these plural interests.'*

In this context disabled people are seen as a subset, a socio-political sphere within the ideology of society. Like other groups in society, disability is lived as an individual experience, as well as a phenomenon seen by others in society. Finkelstein and French (1993) discussed a psychological approach to disability that involved viewing the relationship between impairment and disability.

For the purposes of this research I propose the following definitions from the WHO's International Classification of Function – Beginners Guide (2002, p.10):

> *'ICF has two parts, each with two components:*
> *Part 1. Functioning and Disability*
> *(a) Body Functions and Structures*
> *(b) Activities and Participation*
> *Part 2. Contextual Factors*
> *(c) Environmental Factors*
> *(d) Personal Factors'*

The guide goes on to present the following definitions (2002, p.11):

'Definitions: Body functions are the physiological functions of body systems (including psychological functions).

Body structures are anatomical parts of the body such as organs, limbs and their components. Impairments are problems in body function or structure as a significant deviation or loss.'

Disability is simply not seen as an individual's intrinsic feature but a result of interaction in an environment. The interaction of the same person with the health condition may yield different functioning level in different environments.

This provides an interesting dilemma for the researcher when attempting to find a start point for the presentation of a clear picture of the current level of participation, or any change in service as a result of an intervention. Sport England's National Survey (2002) concludes that participation in sport by disabled adults is 'significantly' lower than for non-disabled adults.

This implies that there is an inequality of distribution of resources available to disabled people. Thomas (2001), states that it is non-disabled people who play the key roles in shaping the opportunities for disabled people to participate in sport. This 'Gate Keeping' phenomenon can cause problems when trying to gain meaningful feedback, and it is the 'what he really means is' kind of research experience which I have worked hard to avoid. It is this pre-occupation which has led me to see research method and social development as an interrelated sphere and perhaps explains my focus on expeditions and fieldwork as a way of providing a format for me to get to the heart of the matter.

1.3.5. Disability Discrimination Legislation in the UK

The biggest change brought about in the disability market was the introduction of The Disability Discrimination Act (DDA 1995). It introduced new measures aimed at ending discrimination against disabled people. The Act protects disabled people in the areas of employment, education, access to goods, facilities and services, and in the management, buying, or renting of land and property. The website direct.gov.co.uk states:

> *'The Disability Discrimination Act (DDA) 1995 aims to end the discrimination that many disabled people face. This Act gives disabled people rights in the areas of; employment, education, access to goods, facilities and services, buying or renting land or property.'*

The growing legislative support for the inclusion of disabled people into society provides a positive backdrop for disability research which has possibly not been seen before.

1.4. Background to Sport and Disability Sport

In this section I look at the key issues in sport to ensure that the design phase of this research is able to benefit from a language which is cohesive and clear. Issues to do with the classification of disabled athletes to facilitate fair competition have been considered previously in order to support the construction of the functional focus for the research. It is from this functional standpoint that the following section on sports organisation should be seen.

1.4.1. The Definition of Sport and Physical Activity

Canoeing can be enjoyed from a range of standpoints, from social participation to competition. Canoeing is recognised as a sport and is administered in the UK by a National Governing Body. It was set up in 1936 and since then the organisation and range of activities and opportunities available has increased significantly (BCU 2006).

As I see canoeing as a sport I need to define the terms of sport itself. Sport has been defined by Singer and Christina (1976, p.28) as:

> *'A human activity that involves specific administration, organisation and an historical background of rules which define the object and limit the pattern of behaviour; it involves competition or challenge and a definite outcome primarily determined by skill.'*

This definition is important for the designer wishing to develop equipment with athletes, as it helps to define the brief for the design problem and the nature of success. Additionally it is important to consider this definition in relation to the nature of disability. This is considered later in this chapter with issues surrounding Adapted Physical Activity (APA) see Section 0.

Extreme examples of the relationship between codified rules of sport and design parameters exist within motor sport, where the shape, structure and dimensions of the vehicle are prescribed to ensure fair competition. Similarly in canoe sport, rules about boat design exist from a competition stand point. In canoe and kayak slalom the boat length is defined, although weights and other dimensions are not. The combination creates a class of boat which is highly specialised, creating constraints for those designing craft for slalom canoe or kayak slalom.

In disability sport, similar constraints to the equipment used also apply. In most wheelchair sports the way in which technology is used is defined to ensure that participants do not use technology to gain unfair advantage. For example, in seated table tennis it is not allowed to have support above the knee, and a participant is not allowed to rest their hand on the table or playing surface to gain additional support, stability or balance.

Sport can be defined in many other ways, including the underlying motivation for the activity; sport can be competitive or non-competitive. This in itself is of little interest to the sports engineer, until one considers the motivation of the individual and their perspective on the data or product feedback which they are exchanging with the researcher. For the purposes of this research we will take the published line of the National Governing Body of Canoeing, the BCU (2006, p.3):

> *'It does not matter if someone wants to have fun on the water, become a hard core river runner or Olympic/ World Champion. Whatever their aspirations, long term paddler development is about giving them the chance to get the most out of paddle sport, being able to achieve their ambitions and realise their dreams.'*

It is from this participative and positive stand point that my research is undertaken.

Before looking further at the structure of sport I would like to look at the nature of play, which is often considered to be at the opposite end of the spectrum to sport. According to Singer and Christina (1976, p.32):

> *'Play is an enjoyable experience derived from behaviour which is self initiated in accordance with personal goals or expressive impulses; it tolerates all ranges of movement abilities; its rules are spontaneous; it has a temporal sequence but no predetermined ending; it results in no tangible outcome, victor or reward.'*

I recognise that sport, unlike play, may place a number of constraints on the designer and participants.

1.4.2. Participation and Performance in Sport

In this section I would like to identify a model to describe the way in which participation in sport can change depending on the level of performance. I would like to do this from a sports development perspective, to ensure that the end result of the research is able to be utilised in the development of opportunities in sport. Bramham et al (2001, p.2) define sports development:

> *'The business of devising better and more effective ways of promoting interest, participation and performance in sport.'*

Bramham et al (2001) review a number of models of sports performance development, all of which are characterised by offering a range of modes of participation in combination with suggesting that there are a range of levels of participation. For simplicity, during this research I have chosen to use a more traditional and simplified sports development continuum by Bramham et al (2001).

Bramham et al (2001) go on to suggest that sports participation can be classified by the competency of the performer, suggesting a model of sports performance; foundation, participation, performance, excellence, known as "the sports development continuum", Figure 4.

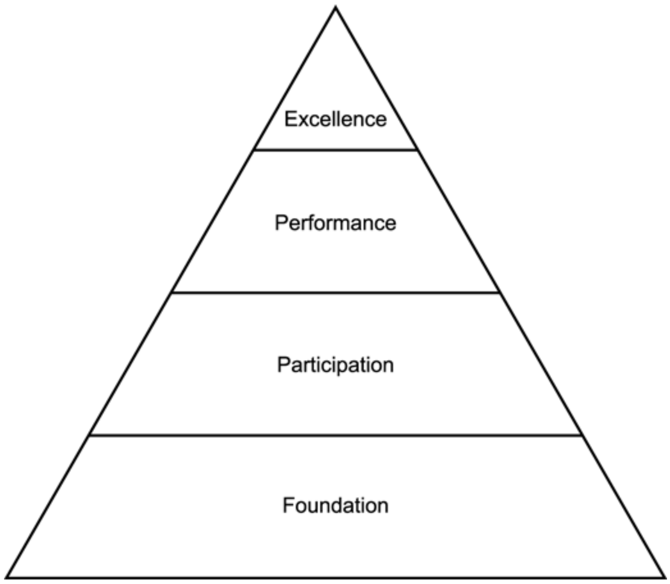


Figure 4 The Traditional Sports Development Continuum

Understanding the nature of performance levels in sport provides an outline framework for the understanding of the aspirations of the participant and the scope of the external performance parameters. This parallels with the way in which undertaking an activity for playful or sporting reasons can affect the aspirations of the primary or secondary user of a piece of equipment. All of these factors have a bearing on the success of a given piece of sports equipment, regardless of its application into disability or mainstream sport.

1.4.3. Who are the Key Stake Holders in Sport?

In this section I would like to look at the key stake holders involved in sport, to help frame any subsequent design research for this study. The reason for considering this is that it is not always the performer or the designer who influences the design and development process.

As already suggested, sport does not exist in isolation, but is related to, and exists within, society. Coakley (1986, p.6) describes this as follows:

'In most industrialised countries sport is related to each of the major spheres of social life, such as family, education, politics, economics and religion.'

In addition to the sociological elements, sport also has a relationship with the commercial world. Coakley (1986, p.65) goes on to suggest that sport has always had a relationship with entertainment and that this has evolved into a commercial framework in modern society:

'… comercialisation has changed sport dramatically.'

It is clear therefore that the designer, when working in the development of sports equipment, is working in a complex field which is highly visible and contains many definitions of success. For the purpose of this study I seek to work on the edge of commercial and media interfaces with sport by working with amateur athletes; amateur being defined by Davis et al (1986, p.327) as 'anything for the love of it'. I remain mindful of the relationship between; sport, society and commercialism.

From this standpoint it is possible to see the structure of Canoesport in the UK and to assess the potential stakeholders in the research. Canoesport in the UK has the following organisational structure; director, board members, discipline and activity specific committee members, regional coaching organisers, course providers, canoe clubs, coaches, individual canoeists (Scottish Canoe Association 2006). For the designer, the key stakeholders may well be defined as the athlete, coach and perhaps experts from the sport. For the purposes of this study my main focus will be on gaining data from the participant and the coach.

1.5. Structure and History of Disability and Sport in the UK

In this section I look at disability sport in its own right. I consider the trends within disability to create a map and context of the work. The relationship between sport and disability in the UK is probably best traced back to the emergence of wheelchair sport at Stoke Mandeville by the famous Dr Ludwig Guttman. According to the International Paralympic Committee (2006a), it was he who opened the spinal injuries centre at Stoke Mandeville Hospital and who introduced sport as a new approach to the remedial treatment and rehabilitation of disabled people.

Hylton and Totten (2001, p.37) suggest that structured campaigns to promote access to sport can be traced to the 1970s:

> *'The original 'Sport for All?' campaign was a creation of the early 1970s and has long since been succeeded by a multitude of subsequent campaigns and causes. But the ideals of 'Sport for All?' still have resonance today as a clarion call for all those involved in sports development. Despite this apparent consensus, the reality of 'Sports for All?' has never been fully achieved, and successes remain incomplete and partial. Gains have been made, but massive inequalities still remain.'*

It is from this transient perspective that I see the structure and support network for Disability Sport in the UK.

Thomas (2001, p.11) defines the structure of disability sport in England as shown in Figure 5.

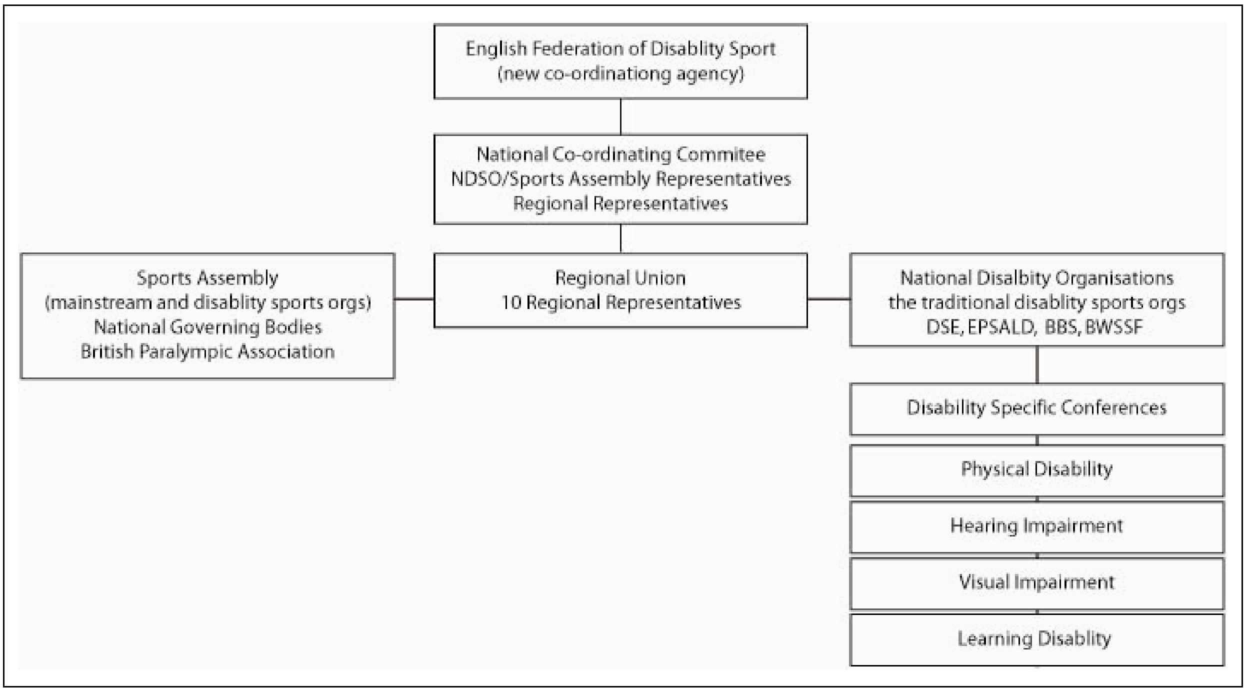


Figure 5 Structure of Disability Sport in England (Thomas 2000, p.11)

The structure currently provides support for a limited number of priority sports, which does not include canoesport.

As a result I have had to use a self-help attitude as a designer, to ensure that this research is not overly influenced by the changing priorities of national programmes, as illustrated by Hylton and Totten's 'Policy Life Cycle'(2001, p.60) see Figure 6.

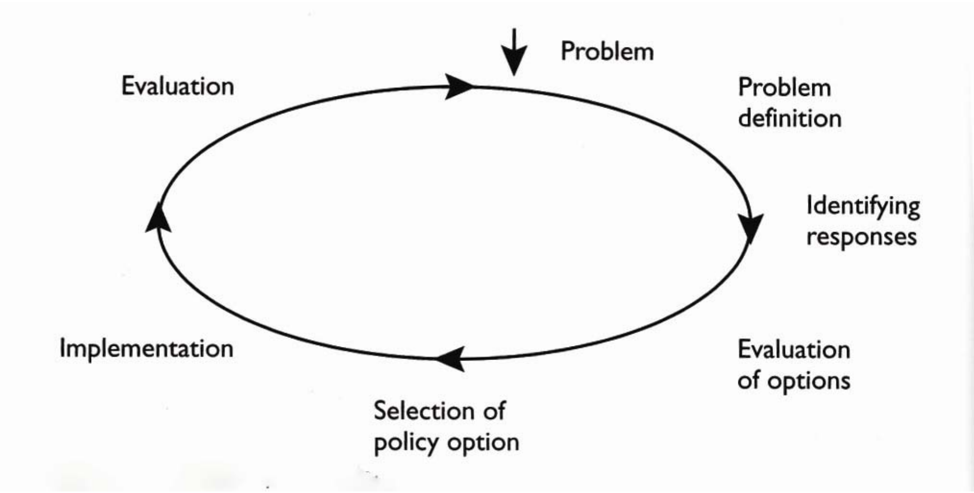


Figure 6 Policy Life Cycle (Hylton and Totten 2001, p.60)

These considerations are important to the research project as they help to frame the potential external resources which create a meaningful legacy for the project. Thus they further help to define what success is in its broadest sense.

1.5.1. Support for Disabled Athletes in the UK

From April 2006, UK Sport's 'no compromise' programme focussed on preparations for the 2012 Olympics, maximizing the podium potential of individual athletes by only allocating funding to sports with past and future potential for medal winning.

With a focus on achievement, the remainder of sport provision that falls outside the spotlight is not consistent. The key factors that affect provision are the focus of the impairment or disability sport group, and the standing of the sport within the national and international sporting arenas. In addition to this, the health agenda and international sporting agendas play a part in the way in which sports resources, and therefore athletes, are able to gain access to support and opportunities.

It is clear that there is not sufficient capacity to provide all opportunities to all people all of the time. It is therefore essential for the sports designer to act in a manner which is able to provide the best effect with the resources available, filling in the gaps wherever possible. Panapek (1984, p.346) describes this as:

> *'Design if it is to be ecologically responsible and socially responsive, must be revolutionary and radical in the truest sense. It must dedicate itself to nature's principle of lease effort, in other words maximum diversity for minimum inventory or doing the most with the least. This means consuming less, using things longer, and being frugal about recycling materials.'*

I see my role as a designer and researcher in this light.

1.5.2. Expectation to Participate at a High Level in Disabled Sport

In this section I outline the nature of opportunities for disabled people in sport in relation to the level of attainment, as outlined in the traditional Sports Development Continuum model (Bramham et al 2001). In a conversation with Will Behenna at the Aspire Centre, Stanmore, on 22nd October 1997, he suggested that the way in which disabled people tend to participate in sport is at either end of Bramham et al's (2001) continuum, i.e. either as learner or as advanced athlete, with little opportunity for being a club participant at an intermediate level.

His suggestion is born out by the experience of running the enquiry service for Equal Adventure, with many enquiries coming from disabled adventurers wanting to move up a level to become an intermediate or independent performer, but lacking the support. It is clear that there is a need for the development of resources to support the needs of intermediate athletes, to help to balance out the continuum.

1.5.3. Self Image - How do Disabled Athletes See Themselves?

In this section I seek to understand the internal attitudes and relationships of the community that I seek to serve. The aim is to understand the potential bias from the end user regarding any potential design compromise. There is evidence to suggest that different groups of athletes with different impairments have social preferences concerning the way in which they see and value other athletes with different impairments. Mastro et al (1996, p.207) state:

> *'Accepting that preference hierarchies exist in disability sport seems a viable first in helping high level administrators better understand the athletes they serve.'*

Williams and Taylor (1994, p.416) in their study of the socialisation process, suggest that socialisation is:

> *'Socialisation refers to the process by which the individual internalises the knowledge, values and norms that are essential to participation in social life. In the context of wheelchair sports it is the process by which individuals acquire the social characteristics that distinguish them as wheelchair racers, wheelchair basketball players and so on.'*

They go on to define culture in the context of disability sport:

> *'Culture refers to the beliefs (both described and normative), values, ideologies norms, artefacts, and social behaviours that are shared by the social group.'*

The concepts of socialisation and culture are important to the process of design, as they once again help to understand the subtleties of what may or may not constitute success. Additionally, it would appear that elite athletes have a bearing on the experience and approaches of non-elite athletes, as stated by Williams and Taylor (1994, p.421):

> *'By far the most important relationship, however especially with respect to the process of socialisation, is that between elite and non-elite racers. Elite racers pass on the proven sub cultural responses to their non-elite racing peers. Elite racers have the relevant knowledge, and they give that knowledge to those who don't have it - to non-elite racers. They pass on the sub cultural material that helps beginners to construct their sporting identities as wheelchair racers.'*

Williams and Taylor (1994) go on to clarify the type of knowledge transferred, suggesting that the key subjects for knowledge transfer are information, equipment and training technique.

In conclusion, it would seem that there is a need to understand the relationships between athletes with different impairments and consider the relationships between athletes of different performance levels when considering any potential feedback concerning equipment design and coaching provision.

Adaptive Physical Activity

In this section I would like to outline one of the key paradigms for the study of inclusive sport and physical activity, Adaptive Physical Activity (APA). APA is used by physical educationalists to help make basic physical sport accessible to disabled people. For the designer of adaptive sports equipment, APA provides a start-point for deciding how to assess what needs to be changed to create successful physical activity for a disabled athlete.

An international definition is given by Doll-Tepper (1994, p.49). as:

> *'Adapted physical activity refers to movement, physical activity, and sports in which special emphasis is placed on the interests and capabilities of individuals with limiting conditions, such as the disabled, health impaired or aged.'*

In addition to this global definition, the core components of APA can be considered as; task, equipment, environment, rule, as shown in, Table 1 Functional Adaptation Curriculum (Hutzler 1998).

Using the basic principles of APA it is possible for the designer to start to home in on the true nature of the problem and to start to define where to act as a designer; whether to change the nature of the activity, the rules, or the environment, to create successful performance.

Table 1 Functional Adaptation Curriculum (Hutzler 1998)

Adaptation	**Description**
	Task Adaptation - Modify or replace original movement pattern into one that is more practical and effective, respecting individual capabilities e.g., shooting to a basket from a seated position in a wheelchair.

Adaptation	Description
	Equipment Adaptation - Change size, form, weight, material of equipment e.g., increased racket surface in tennis, increased ball size and decreased net height in volleyball for easier mastery of the task
	Environment Adaptation - Changes in court dimensions, zones and materials e.g., using half of the original court and a non-volleying zone in badminton.
	Instruction and Rule Adaptation - Modifications permitting the individual more time to perform the task, and a more individually designed instructional method e.g., letting the ball bounce once or twice prior to hitting it in wheelchair tennis or modified volleyball, using peer tutors and guided discovery rather than frontal teaching.

1.6. Current Priorities in Disability Sport Research

In the field of APA, seven research priorities were set by the Committee on Sports for the Disabled, of the US Olympic Committee. Reid and Prupas (1998, p.169–70) refer to these as follows:

> *'The seven areas were identified to influence research directions of disability sport. While a criterion of analysis of DePauw's 1986 article might determine progress of each area, relevant research has been published without reference to that article. Alternatively, researchers*

could conduct a comprehensive review of each area, including a meta analysis where appropriate'.

A full list is given in: Appendix B, Research Priorities in Disability Sport (Reid and Prupas 1998). The key areas being; 1) understanding training or competition effects, 2) training of coaches and officials, 3) technological advances in equipment, 4) sociological and psychological effects of sport, 5) similarities of athletes with and without disabilities, 6) demographics, 7) legal and ethical issues. This research should touch on many of the priorities outlined above.

1.7. Classification and Disability Sport

Classification of athletes is different to APA and is concerned more about how to classify the athletes, rather than how to classify and re-structure the activity itself, in order to include people of differing disabilities in the same activity. Rather than showing how to create an activity, which can cater for the individual's strengths, it provides a framework for understanding the strengths of an individual, so as to create a suitable activity. For the inclusive sports equipment designer, the mix of APA and Functional Classification provide a unique positive standpoint for defining the true nature of an appropriate activity, as well as providing a way of understanding the user without the need to take on complex medical issues. This potential simplicity arguably leaves space for the creative process.

1.7.1. Functional Classification of Disabled Athletes

In this section I look at the classification of athletes in sport. Classification schemes or protocols are used within sport to develop fair and equitable sport.

According to the United States Olympic Committee (1998), the classification process is used to evaluate athletes by disability and functional ability, by placing athletes into competition at an equal start level. They state the two categories of classification as General, or disability specific, and Functional, or sport specific.

Sherrill (1999, p.210) suggests that:

> *'Sport classification in disability sport can be conceptualised as an ever evolving assessment and programming system that strives to make competition equitable and fair'.*

Sherrill (1999, p.210) also suggests that:

> *'a basic goal of classification is to ensure that winning and losing depends on talent, training, skill, fitness, and motivation rather than unevenness among competitors on disability related variables (e.g. spasticity, paralysis, absence of limb segments).'*

Historically, classification in disability sport has grown from a medical or disability approach to encompassing the breadth of human performance. It is required to include participants with the widest range of function. According to the International Paralympic Committee (IPC 2006b), classifications systems have existed in disability sport since the 1950s. The early systems were based on medical diagnoses, while more recent systems include the athlete's ability to perform movements and sport specific tasks.

Classification in sport can be undertaken in a number of ways, in addition to the functional profiling system identified by Meaden (1991) and used by the IPC (2006b). Schemas include; time banding, grouping individuals based on their ability to perform a task at a similar rate to their competitors, classification based on physical impairments, which is similar to a functional classification but groups individuals around a clinical or medical context.

There is little or no documentary evidence which outlines the merits of any one scheme. Anecdotal evidence gained from discussions by Paul with Paralympic athletes at the Sydney Paralympic Games, 2000, suggest the following points for consideration:

> *'A time banding system can be easier for athletes to find a competitor to race against and provide a more exciting race for spectators and the media. Results can also be more readily accessible to those not immediately involved in the race.*
>
> *Classifications based on function or impairment are complex with a sometimes-inflexible system, which can be difficult to adjust.*
>
> *Boosting and faking is possible in any classification system and the integrity of any one classification is upheld by the individual integrity of athlete and official.'*

Current international Paralympic competition is based on function, as stated by the IPC (2006b, p.8):

> *'Athletes are evaluated and assessed taking into account the specific movements and tasks required to compete in each sport (ie. wheelchair propulsion). Athletes from many disability groups may compete together in the same sport class.*

Athletes are evaluated and assessed according to the type, level and degree of impairment (ie. amount of visual acuity). Athletes from the same disability group compete against each other.'

Current research priorities with regard to classification are stated as; current sport specific classification systems, the classification code (IPC 2006b), international standards; and athletes' rights and responsibilities. There is no IPC classification system for canoesport according to the IPC classification code (IPC 2006b).

If one compares the issues to do with classification and the structure of sport, then it is possible to see that classification is one of the key issues in defining what fair competition is. For a designer working in this sphere, the need is not only to balance the needs of the performer, their ergonomic and anthropometric consideration with function, but also to take into account the structure of the sport whilst paying due consideration to the way in which the sport is classified.

A successful design for a piece of adaptive sports equipment would therefore facilitate fair and equitable competition for all those participating in the sport regardless of their functional classification.

1.8. Design

This section explores the key issues in design using western society as a starting point to consider the creative process. It continues to explore the relationship between design and design research, the section finishes by considering the purpose of design.

1.8.1. Design and Society

Design exists within society and its economic and social constructs. Dormer (1991, p.33) states:

> *'Western design is the way it is largely because of the liberal capitalist culture in which it exists and which it serves. Consequently a review of the 'history of design' in the west has to take account of the ideology underlying the recent history of consumerism. Design like consumerism itself, is neither an amoral or political activity.'*

It is from this perspective that I see design, as the perspective quantifies the relationship between design and society. From this perspective it is possible to see that movements in inclusive design discussed below are responses to social forces, which have an effect on both the process and outcomes of design itself.

In the remainder of this section I look at the process of design and am not bound to any social or political movement in itself. I propose to concentrate on the quality of the design process rather than need to focus on the end result.

1.8.2. The Creative Design Process

Design is widely accepted as a creative process and has been defined by Papanek (1984, p.153) as:

> *'AH HAAA'*

In addition to the creative element, design is concerned with the co-ordination of people. According to Csikszentmihalyi (1996), creativity happens in the interaction between people's thoughts and a socio-cultural context and is a system.

Many designers suggest that the motivator for design is outside the individual designer and require the designer to interact with the real world in order to find an appropriate reference point. Seymor (2002), in a leaflet for the British Design Council, states the following:

> *'Innovation starts with people not with enabling technologies or manufacturing plans or distributor preferences. If you forget this for even a moment you run the risk of delivering feature rich rubbish into already overcrowded lives.'*

In terms of sub-classifying design, it can be further defined by both what it seeks to produce and how it seeks to undertake the task. In the context of this research the need is to look at both areas. In terms of outcomes the key concept which relates to disability is that of inclusive design. Black (2006) looks at the interface between inclusive design and user-centred design. She believes that user-centred design is essential to inclusive design, as it ensures the needs of the people who are going to use the products or services are considered, ideally from the earliest stages of the design process.

Black (2006) goes on to suggest that user-centred design brings together practical, emotional and social experiences, creating the opportunity for innovation and improvement in service delivery.

1.8.3. Design and Design Research

Before moving on to look at trends in design, I want to look at the nature of design in relation to research. Black (2006) suggests that design and research are two separate activities which interrelate in order to create appropriate solutions. I consider this relationship between design and research in Chapter 6.

1.8.4. Defining the Focus of Design – Design with a Purpose

It is clear from the previous section that design makes an impact on the world through its co-ordinated use of resources. I argue that there is a need for designers to consider the broader context of their activity, as well as considering the practical and functional aspects of their design activity or problem. Dormer (1991 p.181) states:

> *'One of the most important things designers can do is to symbolise continuity and reflect, both in the form and in the materials and in the processes used to shape the design, an understanding that the object has an impact on the world. This is not to argue for nostalgia, nor to fly in the face of the demands by fashion. It is however, to argue for ensuring familiarity in design – and employing the moral imagination.'*

I consider the moral and ethical considerations of the research in Chapter 2. I now continue to consider the sub-classifications of design which relate to this research.

1.9. Inclusive Design

In this section I explore the way in which design as a paradigm has evolved to include the needs of disabled people. I approach this section as with the rest of the thesis, with the internal belief that it is possible to change the world.

1.9.1. External Drivers for Inclusive Design - Trends in Design Meeting the Needs of a Trans-Generational Society

Papanek (1984) helps to place design within society and the environment. In this section I seek to understand the key demographic drivers which influence design. The Office for National Statistics (2005) suggests that UK society is aging. It states that in 2002, 19.8 million people were aged 50 and over, representing a 24 per cent increase over four decades, from 16 million in 1961. It has stated that the number is projected to increase to close to 27 million people aged 50 and over by 2031 (an increase of another 37 per cent).

With pressures on our society, designers have been forced to rethink some of their priorities. Their focus has had to move from creating products and services for an emerging generation to creating products for the future of the current active generation, as well as products for the current aging society. Keates and Clarkson 2004, p.32) state:

> *'The adoption of inclusive design is in all of our interests because otherwise we will pay the price for it through exclusion, increased taxes, being sued or ultimately being excluded ourselves.*
>
> *The aging process is inevitable and accidents can and do happen. People contract debilitating medical conditions. Some day you along with the majority of the population will almost certainly find yourself unable to do tasks you considered routine. Technology should be the solution to this problem, and can be but only if it is designed correctly.'*

1.9.2. Current Approaches to Inclusive Design and Design for Disability

The response to the aging society and designing for or to include disabled people, has created a number of specific design approaches, as summarised by Keates and Clarkson (2004, p.55-56) in Table 2.

Table 2 Summary of Design Approaches for Inclusion based on Keates and Clarkson (2004, p.55 -56)

Approach	Summary
Barrier Free	Original focus of disability campaigners and architects on barrier free access to buildings and public spaces.
Design for All	European equivalent to Universal Design with the emphasis on information or communication technology.
Design for Disability	A significant tradition mainly focused on aids and adaptations to everyday equipment and buildings. Related to the medical model of disability (and aging), the underlying intent is essentially prosthetic with origins in post trauma rehabilitation, particularly of war veterans.
Design for our future selves	A concept developed at the RCA, through the DesignAge programme, as a way of encouraging young designers to engage with the challenge of designing for people other than themselves.
Modular	Designs that, by virtue of interchangeable units or elements can be configured to suit or fit different users, thus extending the range of users potentially served by a single design or product.
Rehabilitation Design	The primary focus is to enable social participation of disabled people with severe impairments. Much of the work in this area has been concerned with developing one off solutions and specialist equipment for small numbers of people.
Trans-generational Design	Concept developed by James Parkl and colleagues at the University of Syracuse in the USA. Proposes that in an era of population aging, designs should work for people of a wide range of ages and capabilities. Differs from Universal Design and Design for All as it does not place the same emphasis on disability, but takes a market led approach.
Universal Design	Concept originated in the USA underpinned by 7 principles set out by architect Ron Mace. Taken up enthusiastically in Japan. An extension of the idea of

Approach	Summary
	barrier free design. That includes: Equitable Use, Flexible use, Simple and intuitive, Perceptible information, Tolerance for error, Low physical effort, Size and space for approach and use.

With the range of approaches available to the designer, I propose for this research to take a modular approach to rehabilitation design, in the hope that it will provide an insight into the development of more inclusive sports equipment design or inclusive sports equipment design.

1.9.3. A Review of the Functional Models and Modes of Application into Inclusive Design

With a range of approaches available to the designer, the next issue is to define the method of application of the given approach within the design process. It is the functional application of a given approach that I seek to understand in this next section, to identify the appropriate process for the sporting and outdoor context as part of this research.

Keates and Clarkson (2004) suggest a meta-model for inclusive design. The model presents a range of tools; user involvement, user information, analysis, structure, needs analysis, evaluation, user focus and representation. They suggest that each component can be utilised independently or in combination. I review two of the components; understanding user function, and utilising user information or understanding the flow of information in the design process Section 1.9.5. I have chosen these two components in order to assess their suitability as tools for inclusive sports engineering design.

1.9.4. Design Management

In this section I look at Design Management. The key relevance of design management is stated within a British Standard (BS 7000-1 1999, p.8):

> *'More often than not, success is determined by factors other than the technical content of an innovation, not least the manner in which it is launched and sustained once implemented. In some instances, serial innovation might occur with complimentary changes through the value chain: for example, in relations with customers and suppliers. The 'spirals' of innovation that might result should help in technical and market leadership.'*

The Standard (BS 7000-1 1999, p.10) goes on to suggest perhaps softer issues with regard to impact of innovation to society:

> *'Research reveals consistently that success within innovation requires attention to far more than the technical content of products: this might not be understood by customers, or they might take it for granted.'*

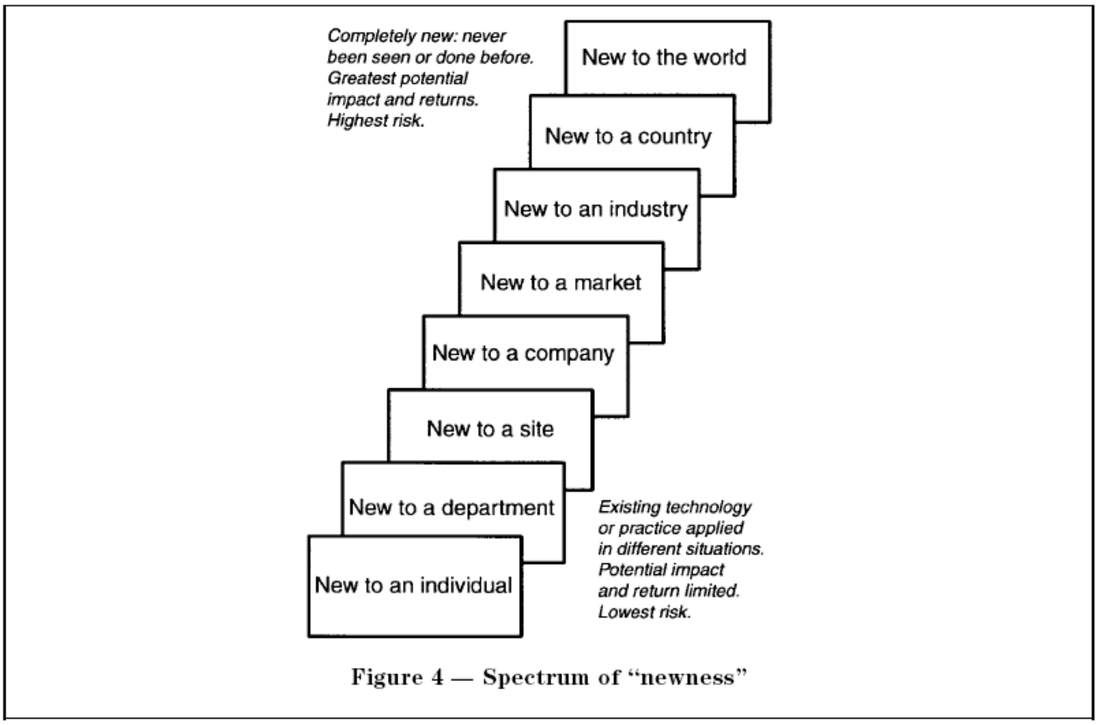


Figure 7 Spectrum of "newness" (BS 7000-1 1999, p.10)

The standard (BS 7000-1 1999, p.17) continues to consider the nature of the product experience for the consumer of a given product as follows:

> *'Customers' satisfaction arises out of their overall experience with products and associated services, including the way in which an organization responds when contacted.'*

This suggests the need for sports equipment design to consider deeply the relationship between the product, artefact or piece of equipment and the sport in its context.

With this multi disciplinary involvement in the process it is possible to see an increased need for management, as stated in BS 7000-1 (1999, p.15):

'Managing innovation has been likened to managing chaos. Innovation certainly thrives on a degree of freedom, therefore an ability to control innovation with a light and enlightened touch is a distinct advantage.'

It is for this reason that I have chosen to look more closely at two elements of the inclusive design process to help to further define the way in which information is managed in the inclusive design process. I also look at the methods designers seek to understand disability in more detail to identify any conflicts in management and communication.

1.9.5. The Inclusive Design Process – Information Management and Functional Understanding

Keates and Clarkson (2004) suggest that one of the key processes for inclusive design is the flow of information. They present the knowledge loop with eight components, as shown in Table 3 Stages to Keates and Clarkson's Knowledge Loop (Keates and Clarkson 2004, p.79-80),which provides an iterative framework involving eight elements. They suggest that the process can be undertaken in either direction depending on the intent, capturing valid user data or designing a product or service, as shown in Table 3 Stages to Keates and Clarkson's Knowledge Loop (Keates and Clarkson 2004, p.79-80).

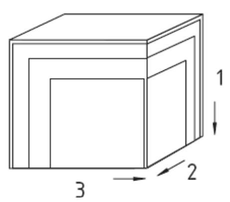
The need for clarity of knowledge transfer is backed up in BS7000-6 Inclusive Design Management (British Standards Institution 2005, p20):

'It is important that all information, especially when compiled by specialist researchers from collected user data, is presented in formats which are accessible to project and team members.'

The standard goes on to use the Inclusive Design cube from Keates and Clarkson (2004). The design cube suggests a structure for defining the focus of the design problem from a user capability perspective.

Table 3 Stages to Keates and Clarkson's Knowledge Loop (Keates and Clarkson 2004, p.79-80)

Step	**Data Usage**
1	Data generated during user trials needs by end users
2	Data capturing from user trials
3	Summary presentations generated
4	Product Validation and acceptability of data
5	Application of data
6	Testing and use of data
7	Use of information by designers and service providers
8	Validation



Key
1. User motor function
2. User cognition
3. User perception

Figure 8 The Inclusive design cube BS7000-6 (British Standards Institution 2005, p.44)

The standard also goes on to suggest a seven level process for the design of complex products, as shown in Table 4:

Table 4 The 7 level design process (BS7000-6, British Standards Institution 2005, p.44)

This provides an interesting framework for the design process and interaction with users in order to gather user data. Further consideration is given to this in Chapter 6.

Level	**Approach**
Level 1	Identifying user wants and aspirations. Defining then verifying the complete problem, including social acceptability requirements.
Level 2	Determining user needs. Specifying the functionality to be provided then verifying the functional specification.
Level 3	Facilitating user perceptions. Introducing appropriate output/feedback mechanisms, then verifying that users can "perceive" (see, hear, etc.) the output from the product.
Level 4:	Ensuring users understand how to use the product. Structuring interactions that match user expectations of how the product should behave, then verifying that users understand the product's behaviour.
Level 5	Ensuring users can interact physically with the product. Developing quality of control and user input, then verifying that the users can control the product without undue physical discomfort.
Level 6	Verifying that the product does what is intended. Evaluating the total product's functionality, usability and accessibility, then validating its practical acceptability.
Level 7	Confirming that users are happy with the product. Evaluating match with user requirements then validating social acceptability.

1.10. The Designer and the Sports Coach

Designers need to understand the whole problem. In his PhD thesis on communication aids, Allen (2002) contemplates the nature of the starting point for designers in relation to the way in which the problem is defined. Allen goes on to say that defining the problem is central to developing the product design brief. For the sports equipment designer, the issue of defining the problem is also central.

Designers need to wrestle with the problem to ensure that they understand the whole scenario and can make wise decisions about what is required. As a result, the designer needs to be able to work with the performer and the coach within Keates and Clarkson's 'Knowledge Loop' (2004), to ensure that there is a clear picture of what is required. Once at prototype stage, the need is to understand how performance is affected and what could be achieved by further development of the prototype or by development of the performer's skills.

From my personal experience, the greatest amount of learning I have been able to absorb has been in observing an outdoor session. In situations where I have been forced into a dual role of coach and designer as a result of lack of resources, there has been a conflict between the research agenda and the logistical and safety issues.

Garratt (2003), in his lecture to the British Canoe Union Level 5 coach conference defined sports coaching as "the stages of learning that a coach goes through in imparting knowledge to educate their students." He went on to discuss the way in which coaches goal set for the athlete, suggesting that it is possible to construct a learning environment built on success and not failure. It is this positive approach to the development of the athlete which is core to understanding the culture of sport.

Coaching can, like design, be seen as a process. Lyle (1999, p.3-24) supports this in his assertion that:

> *'Coaching is a process in that it consists of an integrated, interdependent and serial approach to the achievement of a single (albeit multifaceted) goal.'*

The skill of the sports coach is to define the athletic problems which the athlete should seek to solve in order to develop their skill as an athlete. This process utilises a wide range of interpersonal skills built on the sports coach's personal philosophy. In the development process, the sports coach and the designer must share a common understanding and language in order to discern the required information to aid the design process.

Martens (1990), outlines many of the well documented basic principles of sports coaching. Some of the issues which are perhaps most interesting for the designer are the different styles of coaching in relation to the stages of learning which an athlete goes through. This is important for the sports equipment designer as it illustrates how others involved in sport change their approach to gain best effect throughout the development of the athlete's performance.

Table 5 Practice Principles, Martens (1997, p.81)

Principle 1	Practice the right skill
Principle 2	Practice in contest like conditions as soon as you can do
Principle 3	Keep practices short and frequent when teaching new skills

Principle 4	Use practice time efficiently
Principle 5	Make optimal use of facilities and equipment
Principle 6	Make sure athletes experience a reasonable amount of success at each practice
Principle 7	Make practice fun

The Practice Principles described by Martens (1997, p.81) in Table 5, have relevance to the nature of the performance which is observed by the designer. If the practice is in-appropriate or the technique is incorrect then the feedback received by the designer about the performance of the equipment will be incorrect.

It is clear that as a sports equipment designer, the issue of defining the problem is common. Working with the sports coach facilitates clarity and allows distance from the sporting activity. However, at times it is beneficial for the designer to take on the coaching role (if the designer's qualifications and experience allow), as this allows the designer to gather subtle information about the nature of the athlete's performance and the equipment. A key question is to define where performance starts and equipment finishes, defining the boundaries between performance and the equipment, as shown in Figure 9.

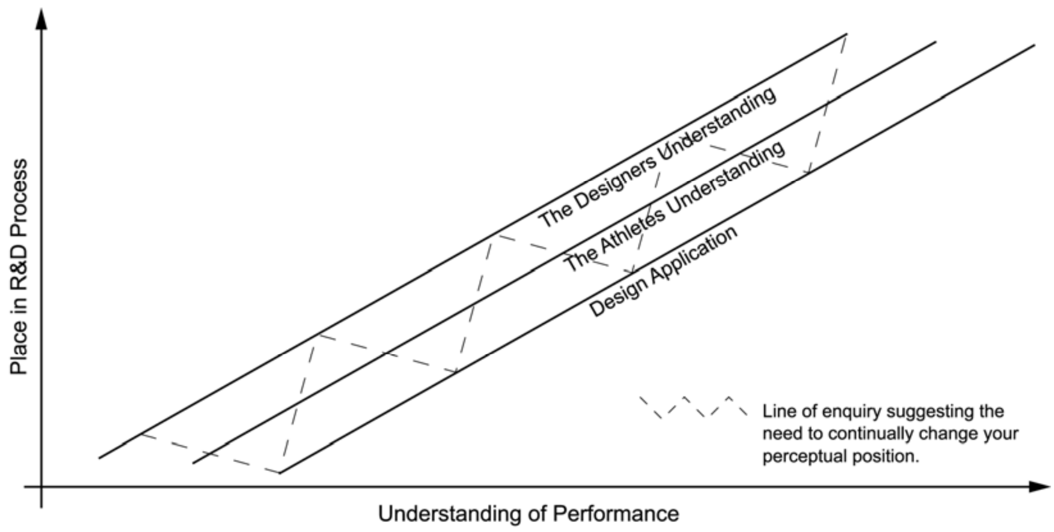


Figure 9 Keeping Your Eye on the Ball Model (Paul 2005) showing the changing nature of the sports design sphere – where does the designer define the start of the problem?

It is only when the problem to be solved is defined that it is possible to start the real design work. By being involved in understanding the performance of the athlete, the designer has the chance to experience the true nature of the problem and therefore apply their skills to solving the appropriate design challenges. I therefore suggest that the most appropriate focus for inclusive sports equipment design is to view design as learning for all involved – the designer, coach and performer.

If one is happy with the perspective that the nature of the design problem is always changing, at least through the initial stages of the sports equipment design process, then there is a need to look at the way in which those involved may see the problem in relation to their learning styles. Beard and Wilson (2002), explore experiential learning, including a review of the work of Honey and Mumford (1992), who suggest that individuals have their own leaning style. The model identifies four key styles of individual learning.

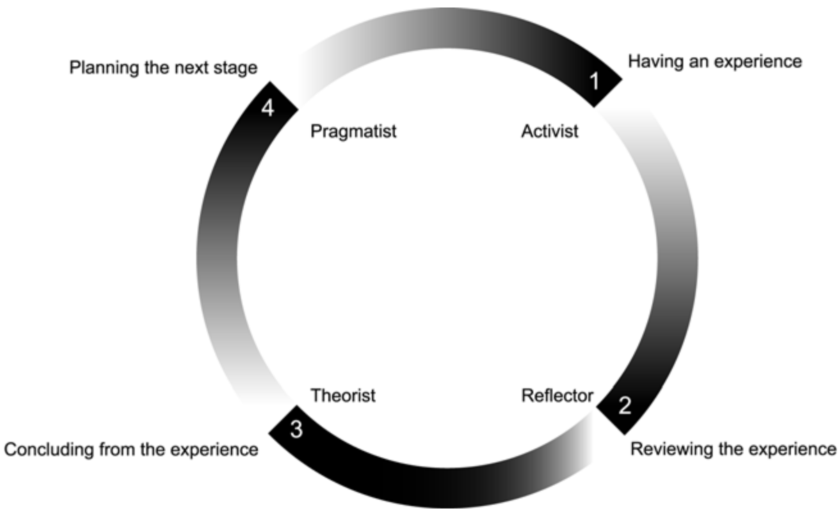


Figure 10 The Cycle of Learning (Beard and Wilson 2002, p.31)

We need to use research tools which allow for the style of learning of both the performer and the design or sports specialist. For example, if the coach is a pragmatist, the performer a reflector and the designer an activist, then one might ask the coach to set the task, gather feedback from the performer following the session and support the designer by allowing for the development of multiple pre-production prototypes. The characteristics of each of the learning styles are given in, Table 6.

In conclusion, successful sports equipment design is only possible when all parties are learning positively about the activity. This provides a contradiction between good sports equipment design and the way in which disability is traditionally seen, and in turn presents a challenge to many inclusive design theories.

Table 6 Honey and Mumford Learning Styles (1992)

Activists	Prefer to involve themselves in the activity and do so in an open minded way.
Reflectors	Prefer to gather the information and carefully consider it before reaching a conclusion.
Theorists	Tend to be systems people who gather information and attempt to develop a coherent theory about the experience.
Pragmatists	Prefer to apply their theories and techniques to investigate if they work.

The Ideal Test Environment

To ensure good design, the correct problem must be addressed, and to do this the athlete or performer must be attempting the correct skill in the right way in order for the feedback about the performance of the equipment to be accurate. If one agrees with this statement then there are a set of criteria for the test organiser which need to be allowed for in order to create the correct environment.

The ideal field trial therefore is one which is able to quantify the relationship between the equipment and the athlete's performance. The environment must allow for all concerned to learn, and when choosing a feedback method it is necessary to ensure that the learning needs of all concerned are considered. Additionally, the correct equipment is provided for the performer's skill level. In conclusion, it is helpful to define:

- The test scenario in relation to the skill level of the user
- The learner or the athlete in relation to the desired outcomes for the test

- The approach in terms of each of the members of the research and development team
- The language or style of communication for all of those involved in the learning based research and development process.

Figure 11 shows where the performance of the athlete finishes and the performance of the equipment begins, which is key to the designer.

Figure 11 Where is the real problem (Paul 2005, p.5)

Defining the real problem can be also seen against Adapted Physical Activity discussed previously in this chapter. The basic process of adaptation of activity which includes the adaptation of task environment, equipment and rule can be added to by further defining the potential outcome. This is helpful in the design process as it provides a method of defining the problem. It may also help provide a structure and language for communication between the coach, performer and designer.

Figure 12 illustrates the sport integration continuum, which is important for the sports equipment designer to consider, as it provides a range of performance options for meaningful participation. It is important that the designer does not focus solely on the equipment elements, so that the true nature of meaningful participation is lost in favour of inappropriate equipment technology.

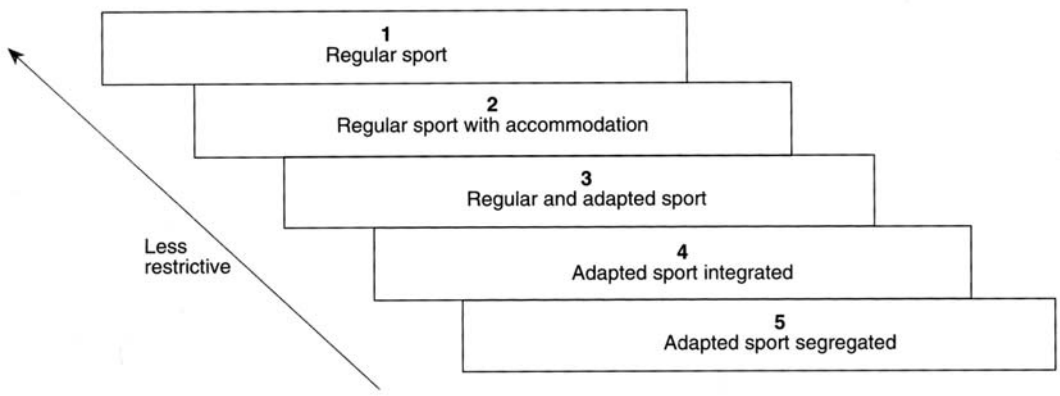


Figure 12 Sport integration continuum (Winnick 1987, p.158)

1.10.1. Problems with Inclusive Design

In design terms, we are talking about approaches which are either bottom up or top down. Keates and Clarkson (2004) define this as designing for the least able user (top down) or extending products to include disabled people by expanding the functionality of the mainstream product (bottom up). Although subtly different, the two approaches can create very different results. For successful sports design, both approaches present difficulties. The basic premise of sport is performance, with performance presented in a positive way. Therefore if one takes a reductionist or negative approach to disability, then the design approach does not fit the outcome in sporting terms.

1.10.2. The Need to Find a Positive Start Point for Sports Equipment Design

It is a simple task to define disability if one is satisfied with a largely negative view of human function. Taking a functional approach, some would argue, is sufficient to place a positive spin on the approach. However, this does not fit with sport as sports coaches, as discussed above, are taught to build on performance, utilising a positive coaching process and developing the skill of the athlete or performer.

The inclusive sports designer is better served to develop perceptual models of human function which are based on ability not disability. This approach is commonly encouraged in Disability Awareness Training and reflected in titles used by disabled sports organisations in the UK e.g. Skiability – a skiing organisation for disabled people. My experience tells me that, beneath this positive front, the detail is often based in the clinical paradigm of disability, built on the concept of deficit. For example, if one looks at the current model of disability presented by WHO (2002), shown in Figure 13 and Table 7, then many of the issues concerning a sports coach are represented. However one of the key focuses is still to define the disorder or the disease as well as defining the participation restrictions. This has its benefits for planners, but it still presents disability as something different or outside the norm.

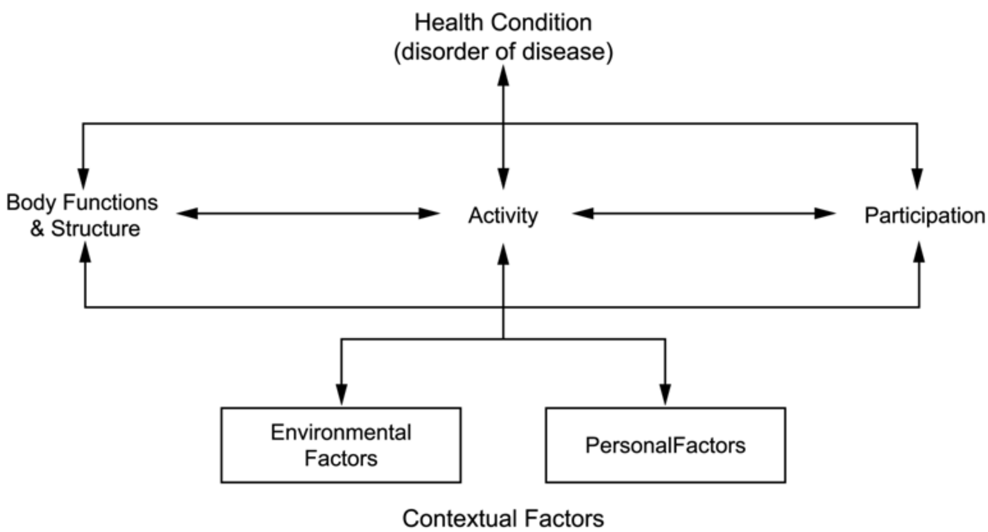


Figure 13 International classification of function (ICF) (WHO 2002, p.9)

The notion that inclusion can be defined purely on a positive basis is a concept that I have struggled with for some time, and as a designer working closely with the coaching process I have changed my language from a functional stance, to a more positive coaching-aligned language which works on what people can do, rather than what they cannot.

Table 7 The Components of the International Classification of Function (WHO 2002, p.11)

Body Functions are physiological functions of body systems (including psychological functions).
Body Structures are anatomical parts of the body such as organs, limbs and their components.
Impairments are problems in body function or structure such as a significant deviation or loss.
Activity is the execution of a task or action by an individual.
Participation is involvement in a life situation.
Activity Limitations are difficulties an individual may have in executing activities.
Participation Restrictions are problems an individual may experience in involvement in life situations.
Environmental Factors make up the physical, social and attitudinal environment in which people live and conduct their lives.

Again this method of understanding impairment and disability can be seen against the APA model of performance and the design model of performance.

1.11. The Outdoors and Expeditions

In this section I introduce outdoor pursuits and canoe sport. Outdoor pursuits, is often used loosely in common parlance. The aim of this section is to introduce some definitions surrounding activities in the outdoors to provide a structure within which to see canoesport and expeditions.

Priest and Gass (1997) suggest the following definitions, shown in, Table 8.

Table 8 Definitions of outdoor terms Priest and Gass (1997, p.17-18)

Experiential education	Learning by doing with reflection
Outdoor education	Follows the experiential philosophy of learning by doing. It takes place primarily but not exclusively through involvement with the natural environment.
Adventure education	A branch of outdoor education concerned primarily with interpersonal and intrapersonal relationships
Environmental education	A branch of outdoor education concerned with the human relationship with the ecosystem and natural resources.
Recreation and Outdoor Recreation	Activities which take place during leisure time, outdoor recreation is recreation in an outdoor setting.
Outdoor pursuits	Human powered form of outdoor recreation.

Canoesport therefore can be seen as a form of outdoor pursuits, and can be further modified depending on the underlying intention of the activity being undertaken, be it for recreation or for education. When seen in a competitive or codified sense it can also be seen as a sport. In this research I take a sporting approach to this research but acknowledge that for some of the participants in the research there may be a range of additional experiences which can be placed loosely within the framework given above.

1.11.1. Expeditions and Fieldwork

According to Fowler and Fowler (1964), the expedition concept entails a journey or voyage with/for a definite purpose. This dictionary definition is also supported by Nigel Winser, who in his opening remarks at the Explore International Planning conference in November 1997, suggested that expeditions are a journey that is usually exploratory and scientific or adventurous in nature.

Winser (2004, p.255) suggests that the primary aim of fieldwork is:

'to further our knowledge about the world in which we live.'

Winser (2004) notes that there has been an increase in the number of inclusive expeditions.

The Market Research Society (2006) suggests that fieldwork is concerned with surveys, observation and experiment, when considering fieldwork from a marketing or commercial standpoint.

Brymer (2000), in his study of the experiences of an inclusive team on the river Ganges 1998–99, suggests that an expedition can be assumed to be a place for the development of leadership potential and team development. He goes on to suggest that there is little known about the appropriateness of these assumptions. For the purposes of this research I propose to utilise expeditions as a way of gathering research on the internal participants of an expedition team, building on Brymer's (2000) work and taking it into the development of equipment rather than teams. I look at this further in chapter 5, when considering methodology, and in chapter 6, when considering fieldwork practice.

1.11.2. Sports Equipment and Performance

Performance in sport and the development of sports equipment go hand in hand. New equipment helps to ensure that this generation of athletes is able to outperform the last. In Adventure Sports, designing equipment to improve quantitative performance can be replaced with other qualitative performance issues, like independence. Parsons and Rose (2003) track the development of mountaineering equipment in relation to climbing Everest. This illustrates a link between the outdoor performer and the designer – the mountaineer searching for appropriate equipment and the designer responding.

So what is special about designing for disabled athletes? The aim is still to develop equipment which promotes performance. Much of the literature and the reported approaches concerned with designing to include disabled people start from a negative start point, this being the need to replace or fix something. Mountaineering and outdoor design starts from a more positive stand point, designing or making something which is up to the challenge. It is from this positivist standpoint of facilitating challenge that I see the use of technology in sport.

1.11.3. Why Design and Expeditions?

Expeditions can be defined as a journey with a purpose. For many the most obvious purpose is a scientific one, but in this section I look closer at the way in which expeditions have been used as a mechanism for social change or sports development in the outdoor sector, partnered with technology innovation and design.

Expeditions have a long record of testing equipment to the limit and providing feedback to developers. The relationship often involves a sponsor, an athlete or expeditioner, and a manufacturer. If managed correctly, expeditions have proven to provide an ideal hot-house, where the developer gains feedback, and the athlete or explorer gains a fantastic experience which is often meaningful and self generated and may even gain them notoriety.

In sports development and the creation of new opportunities, the expedition has often been a precursor to developments in outdoor sport, to the benefit of the whole section of the outdoor community, not just the lead user. It is not unusual to see expedition images used in advertising campaigns as inspirational images, either tagged with a just-do-it kind of by-line or a just-do-it-with-us kind of by-line. It is this use of expeditions as a social promiscuity note, which equipment manufacturers use to sell the forthcoming year's fleece or Gortex jacket.

For the designer seeking feedback, the expedition perhaps provides the best situation for testing the defined brief in an exact time scale with a known set of participants. I propose that expeditions are an ideal place to gain user feedback and ensure participation in data gathering, providing some attention is paid to the quality of the methodology and feedback. In addition, if managed correctly, expeditions also provide a framework for the public understanding of science.

2.

Chapter 2

Ethical Rationale for Research

2.0. Chapter Introduction

The aim of this chapter is to provide an ethical rationale or framework for the research, in terms of its focus, method and use of resources. Section 2.1 provides a definition of ethics as a corner stone for this chapter. Section 2.2 outlines the ethical standpoint for the research, presenting the following cases for the focus of the research; rights-based, best use of my time, quality of life and research as truth. The section concludes with an exploration of the use of resources in Western Society as a metric for the reasonable application of resources for this issue in society.

Section 2.3 presents the rationale for the sporting focus of this research in terms of its benefit to disabled people and society as a whole. In section 2.4, I consider the benefits of this research to sport and outdoor activity for disabled people. In Section 2.5 I look at this in more detail, as I look at the importance of this research to coaching of sport. It considers ethical issues surrounding sports coaching, examining the experience of the athlete or performer from a holistic standpoint. In section 2.6, I examine the rationale for looking at posture as a start-point for the problem statement for the design element of this research. Section 2.7 reviews the benefit of this research to design theory. In the final section of this chapter, 2.8, I look at the ways in which this research may impact upon society, to create meaningful, positive social change through the creation of opportunities for disabled people in outdoor education, out of classroom learning and fieldwork.

2.1. Ethics

In section 2.2 I outline the ethical standpoint and rationale for my research. According to Thompson (2000, p.1), ethics can be defined as:

> *'Ethics is about moral choices. It is about the values that lie behind them, the reasons people give for them and the language that they use to describe them.'*

The need for this consideration is underlined in the Guidelines for Researchers and for Research Ethics Committees on Psychiatric Research Involving Human Participants, (2001, p.iv) which clearly states that:

> *'The responsibility for the ethical conduct of research rests firmly on the principal investigator.'*

Section 2.2.2 of this chapter provides a value based argument for the research. The key focus here is the justification of the research paradigm against a range of social needs. Simply put, the aim is to ensure that the remainder of the chapter and thesis is able to concentrate on research outcomes rather than campaigning. This section asks questions like, why research, and why undertake research in this area?

Sections 2.5 to 2.6 look at the rationale for the exact focus for the research in relation to its potential benefits to the individual and the knowledge base in the paradigms of sport, design and coaching. Section 2.8.1 looks at the way in which these benefits could interact to create a possible change for society as a whole.

2.2. The Ethical Standpoint for Research – Dissolving the Soap Box

In this section I outline four concepts which underpin the need for this research; rights-based, use of resources, best use of my time, and quality of life. The final part of this section suggests that there is no need to justify research, as it is arguably the only truth.

2.2.1. The Rights-Based Argument

This section considers the rights-based argument as a justification for the research. The Declaration of Human Rights (United Nations 2000) provides a basic tenant for my work, stating the need for social progress:

> *'Whereas the peoples of the United Nations have in the Charter reaffirmed their faith in fundamental human rights, in the dignity and worth of the human person and in the equal rights of men and women and have determined to promote social progress and better standards of life in larger freedom.'*

This is a foundation for a rights-based argument which justifies the need for research, and enables all participants to take fair and equal part in all activities.

2.2.2. Use of resources

In a world of limited resources, the need is to achieve positive outcomes for society without appropriate use of these resources. This is reaffirmed by the UK's Department of Trade and Industry (DTI 2006), in their definition of sustainable development:

‘development which meets the needs of the present without compromising the ability of future generations to meet their own needs.’

The environmental consequences of ‘everything for everyone’ is a concept which is increasingly well documented. A clear example of this is the amount of resources used by the city of London. According to London Remade (2006), London’s ecological footprint is more than twice the size of Great Britain.

For the designer of new equipment who ultimately utilises new resources, this conflict presents a range of challenges both during the design phase and during any subsequent manufacture. There is an important need to consider deeply the concept of trying to answer the right sporting question to minimise waste.

Much work has been done to justify the use of resources in health care, for example the development of the Quality Adjusted Life Years as a calculation for deciding on the best use of health resources (Phillips & Thompson 2001, p.2):

‘The outcomes from treatments and other health-influencing activities have two basic components – the quantity and the quality of life. A QALY is the acronym for quality adjusted life year, which embraces both of these components and is the arithmetic product of life expectancy and a measure of the quality of the remaining life years.’

On a societal level, Endriss et al (2001) consider the way in which agents within society are able to negotiate their way into the appropriate level of resources, to enable the best outcome for a given society. This makes a quantitative assessment of what is required by society.

2.2.3. Best use of my time – the foundation of the life of a designer

Papanek (1991, p.86), in his chapter on Obsolescence and Value in Society, starts with a quote from Fuller:

'You have to make up your mind either to make sense or make money if you want to be a designer.'

The outdoors is my 'sense', so on a personal note this study will formalise and legitimise an approach for future research in this area. From a Christian perspective, Mathew 25:14-30 (International Bible Society 1988) suggests that making the best use of one's talents is the most appropriate course of action. This thesis provides the academic and theoretic rationale for the development of Equal Adventure (EA), a social enterprise based in the Cairngorm National Park. EA is supported by a number of commercial and charitable organisations, who provide a multidisciplinary vehicle for the long term development of inclusive opportunities in outdoor sport for disabled people. The mission statement for the organisation is (Equal Adventure 2006):

'Equal Adventure (EA) is a not-for-profit social enterprise, addressing the growing social responsibility required by all organisations and service providers to become more inclusive. EA has created three service areas that bridge the gap between providers, products, services and consumers. Our service areas are split into information (EAI), training (EAT) and product development (EAD).'

2.2.4. Quality of Life as Self Actualisation

Humanist approaches to psychology, such as Maslow's whole person approach and Roger's person-centred approach, fit with the approach of sport as they evaluate the holistic approach to human potential. I see my research in this humanistic positivist stance. Hill (2001) discusses the work of Maslow and other humanist psychologists, and suggests that man has a number of needs or requirements to maintain a reasonable life. The hierarchy lists physical and emotional needs before the state of self-actualisation can be achieved.

I argue that providing access to an engagement with the outdoor environment can help people to achieve their state of self-actualisation by providing for their basic needs. This was illustrated to me during a conversation with David Constantine, Director and Founder of the charity Motivation, whose mission is to provide wheelchairs for the developing world. The conversation took place at the Royal Geographical Society during the 1995 ‘Disabled Explorer Conference’. I asked if as a recently graduated designer I should pursue my dream of developing the first ever Climbing Harness for Disabled People. I explained the dilemma that I had with regard to the focus of my efforts, in that I was struggling with the need to focus on something more basic than inclusive outdoor sport. David, who spends most of his time travelling the world using a wheelchair and some assistance, suggested that he would love to be able to sail or escape into the wilderness to help find some balance, but there was nothing which he could use to help him sit upright in a boat. This dream was taken into account when undertaking research for the AQUABAC (Equal Adventure, 2006) some years later, which in part led to this PhD research.

2.2.5. Research and Truth

Robinson and Garratt (2004, p.30) suggest that one of the basic tenets of the Philosopher Socrates was the assertion that:

> *‘The most important thing about human beings is that they ask questions […] real knowledge comes from discussion and argument, and discovering, it is a cooperative venture.’*

From this standpoint it is possible to suggest that there is no need to justify research so long as it is safe, as we do not know what we will find until we get there. Prejudging research therefore invalidates it.

The remainder of this chapter provides the background structure for measuring the societal benefits of this research and justifies 'developments in inclusive outdoor adventure' as a paradigm.

2.3. Rationale for Research Focus on Sport

In section 2.3, I outline the need for research in this area with regard to the potential benefits to the individual.

The importance of physical activity for disabled people is illustrated by the WHO (2003), who state that lack of physical activity is a major underlying cause of death, disease and disability. The WHO (2003) encourages governments to provide access to play and sporting facilities to improve health. The UK's Department of Culture, Media and Sport (2002) identifies this link between physical activity and health in its strategy, stating that sport can be used as a way to gain significant health benefits as well as reduce the growing health cost of inactivity.

Exercise is a vital part of everyday living for everybody. Not only does it improve physical abilities, but it also helps people build up and maintain confidence. According to Heath and Fentem (1997, p.195), exercise is even more important for disabled people because:

> *'More importantly, other studies consistently provide evidence that participation in regular physical activity among persons with selected*

impairments and disabilities results in improved functional status and quality of life.'

There are virtually no limits to the sporting and leisure activities that disabled people can enjoy, whether indoor or outdoor, active or not so active. However, a report commissioned by access4fitness (2001), found that 96% of UK fitness centres in the private sector did not have fitness equipment for disabled people. 74% in the public sector did not have inclusive facilities either. Research also highlighted a lack of awareness about disabled people's exercise needs and benefits, including a lack of disability knowledge amongst training instructors and facility staff.

2.3.1. Participation in Sport by Disabled People

I now look at the way in which positive design development can affect the choices available to disabled people in society, and in turn affect the way negative or static images of disabled people can be challenged.

Focusing on the creation of choices in sport and active lifestyles, Hylton and Totten (2001) suggest that the first UK national drive toward inclusion in sport started in the 1970s with the 'Sport for All' campaign. Their analysis suggests that participation in sport is dependent on an individual's socio-economic status, but they do not provide an analysis of issues surrounding disability and participation in the UK. Data on the participation of disabled people in sport is much more difficult to find, though Sport England's National Survey (2002, p.65) concludes:

'Sports participation rates for disabled adults are significantly lower than for non-disabled adults. This is true for people with a wide range of disabilities.'

Hylton and Totten (2001, p.45), suggested that 'sport has been said to be a mirror of society'. Challenging the lack of opportunities available in sport for disabled people through sports equipment design could create a new mirror image of society and helps to promote the inclusion of people in society.

2.4. The Importance of Outdoor Activity for Disabled People

In this section I look at the reasons for focussing on access to the outdoors, in all of its contexts - recreational and educational, through science and fieldwork.

Priest and Gass (1997) suggest that the range and scope of outdoor experiences includes three distinct but inter-related areas: environmental education, outdoor recreation and adventure experiences. As mentioned in Chapter One, I see this as my framework for understanding activities outdoors and would like to use it as the starting point for introducing outdoor activities involving disabled people.

2.4.1. Threats to Access to Outdoor Activities for Disabled People

Outdoor activities in the UK for disabled people are under threat due to the conflict between the DDA (1995) and the Adventure Activities Regulations (2004).

The Legislative imperative which has been created by Part III of the DDA (1995) is that all people must have reasonable access to educational opportunities and services. This is set against the Adventure Activities Regulations (2004), which state that all outdoor activities must be undertaken safely and responsibly. A conflict arises with the use of the word 'reasonable', as this remains undefined within outdoor activity provision. A lack of training and support to educational service providers in meeting the needs of both legislative frameworks, meeting what is reasonable and how to deliver their service safely and responsibly, has produced a negative reaction in the outdoor industry. In the past, disabled people have often been included in outdoor activities by improvisation with equipment, techniques and coaching, but in the light of new legislation, this does not hold.

At the Institute for Outdoor Learning's National Conference in March 2002, the author presented a summary of both pieces of legislation side by side. There was only one question posed by the audience:

> *'What do we do now?'*

The legislation and this question add purpose to this PhD research, as a means to define, 'What we do now', in support of the outdoor industry as a whole.

The findings of a study (Carpenter 2005) organised by the author, undertaken with St. Martin's College, Ambleside, suggest that across all areas of disability, outdoor providers are not able to provide an equitable service, but the most disparity exists with physical disabilities. According to Carpenter (2005):

> *'The results suggest the Outdoor Industry is not meeting the needs of disabled people in the inclusive way that is now expected, and whilst significant efforts are being made to address the requirements of the Disability Discrimination Act, access to facilities does not meet current standards. The research also identifies that service providers need to address the lack of inclusive marketing information available, and actively encourage the participation of people with disabilities in outdoor activities.'*

Although this study cannot be considered as representative of the whole industry it does suggest that there is potential for conflict. The study suggests that the conflict stems from a lack of understanding of physical disabilities, and from a lack of appropriate equipment. Without an understanding of these concepts, there remains an inherent lack of confidence in marketing inclusive activities.

The products developed in the course of this PhD research help fill part of this gap. Deeper thinking about the methodology and the development process which results from this PhD will also make it possible for further equipment development to be feasible and sustainable. These developments may well then be used as a driver for marketing and delivering inclusive opportunities.

In a broader context, this PhD study is timely, as it fits into a current societal issue with regard to the place of adventure and risk. This topic is being tackled by the Campaign for Adventure (2006):

> *'The Campaign seeks to show that life is best approached in a spirit of exploration, adventure and enterprise; to influence and better inform attitudes towards risk; to build wider recognition that chance, unforeseen circumstances and uncertainty are inescapable features of life and that absolute safety is unachievable; and to demonstrate that sensible education and preparation enable an appropriate balance to be achieved between risk & safety and achievement & opportunity.'*

2.4.2. Access to Science and Environmental Education

Research for the Field Studies Council (Rickinson et al 2004) suggests that fieldwork can have a positive impact on long term memory, due to the memorable nature of the fieldwork setting. Providing equipment which encourages access means that disabled people are also able to gain the same educational benefits which fieldwork offers to non-disabled young people. According to the Department for Education and Skills (1998, paragraph 89):

> *'Every effort should be made to ensure that school journeys and activities are available and accessible to all who wish to participate, irrespective of special educational or medical needs, ethnic origin, sex, religion etc. All young people should be encouraged to participate in as wide a range of activities as possible.'*

The Department for Education and Skills (1998, paragraph 1) also states:

> *'A positive response by the school to a pupil's medical needs will not only benefit the pupil directly, but can also positively influence the attitude of the whole class.'*

It is clear that inclusive, integrated broad-based educational experiences are core to the National Curriculum and that out-of-classroom learning has major benefits to learners of all ages. Providing equipment which facilitates this and removes barriers to education and inclusion, makes it possible for educators to concentrate on the delivery of the National Curriculum, rather than on solving the mobility or equipment needs of a disabled learner in their charge. This also clears the way for disabled young people to aspire to become young field scientists and engage in self-led research beyond school.

2.4.3. The Campaign for Adventure: Adventure For All Outdoor Pursuits Risk and Disabled People

Many would argue that we are becoming risk averse and that it is increasingly difficult to undertake day to day activities without becoming obsessed by health and safety issues. From my own personal experience of setting up an independent social enterprise, I have found it extremely challenging to find any insurance cover for my activities. Mentioning disability and adventure in the same sentence seems to conjure images of activities which lie outside the accepted realms of the insurance envelope.

In the remainder of this section I would like to illustrate, the broader developments in society with regard to outdoor activities and perceived risk. Much of the following work has been inspired by the Campaign for Adventure (2006), which seeks to ensure that adventure activities and the right to take reasonable risk stays on the educational agenda, thus safeguarding the future of educational field work, outdoor activities and off-site safety. According to Rose (2005, p.47):

> *'The involvement of learners in their own risk assessments is of importance. Risk assessment can be an opportunity for learning, especially for learners with learning difficulties.'*

From an experiential education perspective, this is important as it suggests that risk is a legitimate subject to be explored. Prime Minister Blair (2000) stated:

> *'Everything we do in our everyday activity, in our work and leisure, involves some element of risk. Risk is an inescapable part of our lives. The challenge for all of us [...] is to manage risk in a way which gives us the necessary protection we need without constraining what we do beyond a level that is justified.'*

From a designer's perspective this is important as it strengthens the view that the user of any piece of equipment needs to be responsible for the way in which they use the equipment rather than placing all of the responsibility on the designer. Blair's government (Qualifications and Curriculum Authority 2004) supported the role of adventure as part of active education, and recognised the help it offered young people in learning about assessing and managing risk, learning about leadership and teamwork, while also offering new and exciting challenges.

2.4.4. Access to Personal and Social Development Through Outdoor Activities for Disabled People

A research review undertaken for the Field Studies Council (Rickinson et al 2004), launched at its 60th birthday celebrations, suggested that Outdoor Education itself, without the fieldwork or science component, has also been shown to have benefits to young people including in their attitudes, beliefs, self perceptions, and interpersonal and social skills.

The Field Studies Council states (2004, p.6):

> *'There is also a smaller link in literature which suggests that Outdoor Education benefits for young people in terms of the general and specific academic skills, the promotion of positive behaviour.'*

From a therapeutic and health standpoint, the ability to escape concrete and tarmac, engaging in the outdoors or nature, develops an individual's sense of freedom and benefits mental health. The Scottish Forestry Commission also recognises this, suggesting that the outdoors is a resource for people to develop their fitness. During 2004, the Scottish Executive organised a conference on Forests, Trees and Human Health and Wellbeing (Clarke, 2004), during which parties across Europe were urged to encourage their citizens to use the natural environment to develop their health by using the outdoors as a gym. This approach complements the work of the IFI (2006), which has recognised the importance of providing fitness facilities for disabled people, both indoors and out.

2.4.5. Developing Performance Pathways in Outdoor Activity

As seen in Chapter one, levels of participation in sport vary. The focus of this research is to build on the author's foundation research in the subject area (the Aquabac postural support system aimed at foundation level disabled participants in watersports). I propose that this PhD research focuses on the needs of the next level of sports performance, which in the traditional model of sports development is levels two and three, i.e. Participation and Performance, as described in Chapter one.

The successful completion of this research will provide an opportunity for disabled people to move from grass roots participation to a more advanced level, where skills can be developed whilst maintaining dignity, control and safety.

The work also provides a basis for developing a greater understanding of how people with limited sitting balance are able to kayak in a more skilled manner. This has a positive benefit on the education of canoesport coaches, something of which I have experience through the delivery of practical disability awareness training for National Governing bodies, such as the Welsh Canoe Association, Scottish Canoe Association and the Mountain Leadership Training Board.

2.5. Coaching in Sport

In addition to this, the development will allow outdoor coaches to concentrate on coaching the necessary techniques and skills rather than having to focus on the equipment needs of the disabled learner. By developing this equipment, it also reduces the hassle experienced by aspiring intermediate level learners, who seem to spend great lengths of time during practice sessions adjusting equipment to enable their performance, rather than engraining sound technique and a solid skills base. This view is supported by leading UK canoesport coaches from both National Training Centres – Glenmore Lodge (Scotland) and Plas y Brenin (Wales). As stated by Collins (1999):

> *'Remember, better practice leads to better performance. If the equipment is constantly changing then the nature of the skill is constantly changing.'*

2.5.1. The Need to Look at the Whole Individual and their Context in Daily Living

Figure 14 (Winser 2004, p.26) explores the relationship between care needs or preparation time of people, and available leisure and work time. It illustrates simply that the more time spent adjusting equipment, i.e. preparing to participate, the less time is available for meaningful practice or leisure participation.

The 'day' represented in the diagram could be taken as being any period of time, and could be replaced with the word 'session' when considering a period of sporting practice. For components within the diagram, 'work' simply refers to economic activity or occupation, while 'leisure' could then be described as free time outside of work which is not required to perform daily living tasks, in the diagram abbreviated to 'care'.

The diagram shows that as an individual's personal care needs increase, their leisure time initially suffers; if care time is increased again then both work and leisure time are compromised.

The concept of the interdependencies of the elements of the components of an individual's day is important to both the coach and the designer, as it provides a contextual framework for understanding the broader external pressures on the individual outside the sporting or test arena. This is important as it helps both the designer and the coach better understand the context of the feedback which they are likely to receive.

In terms of opportunity and the application of new technology as a way of inspiring social change, the model provides a framework to understand some of the barriers which may bias the uptake of new opportunities regardless of investment. The model has significance for this research, as it illustrates the need to consider the whole of the problem, not just the technological or design issues, but also the interdependencies between the aspects of a technology's application, the individual situation and the aspirations of the user.

In terms of success and goal setting for further study, the model provides a way of assessing the knock-on effects of a trial which may not be evident during the event. Using a model which takes into account the whole of the performance situation is essential, as it creates an opportunity for eliciting information about the effect of the trial on the whole person or how a change in the person's circumstances may affect their performance during a trial.

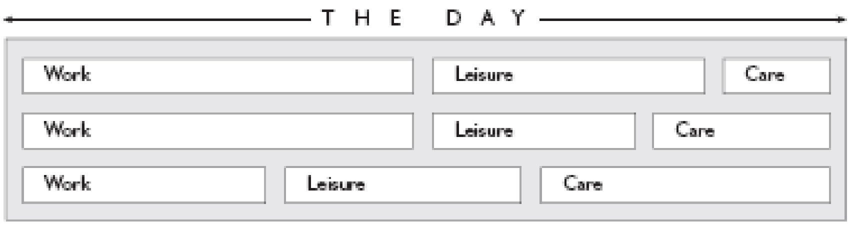


Figure 14 The Expedition Day – Winser 2004, p.26)

2.5.2. Why Look At Coaching?

Papanek (1995) suggests that the designer is forced into the role of interpreter due to the highly technical requirements for the other team members to tackle the problem. As a result of Papanek's assertion, I would argue that one of the key stakeholders in sports equipment design is the coach. I argue here that the focus of the research should be on the interface between the coach, the designer and the athlete, rather than the sports scientist.

Sports performance can be measured in a range of ways. Higher, faster and longer are standard quantitative metrics used in track and field or athletics. However, in adventure sport the need is not always to go faster or longer, but can often be to go safer or with more control, which are more subjective metrics. The need therefore for the designer is to be able to measure success against these less certain metrics, or create a model of performance which enables them to define what is success.

Additionally for the designer working in sport, the need is not just to observe 'the what' but to also understand 'the why', in order to make informed design decisions. By helping set the metric with the performer, the coach can ensure that the measure of success is more valid. This reinforces the coach's involvement in the design process.

Taylor (2006) suggests that coaching consists of a number of behaviours; direct intervention, process management, constraints management, strategic co-ordination. Within the process management, Taylor (2006) suggests that the coach supports the learner in choosing equipment. This research will help to develop a language which presents specialist equipment in a more easily understood format, reducing the cognitive load on both the performer and coach, thus allowing them to concentrate on performance rather than equipment selection.

2.6. Why Look At Posture?

In this section I outline the importance of posture within the outdoor environment. The nature and understanding of good posture is dealt with in Chapter 3, with issues to do with seating. The importance of good posture provides a start-point which ensures that the quality of performance is focused upon, by both the athlete and the coach. Good posture is essential for gaining dignity and control over a situation. Imagine looking at the floor all the time and having to ride a bike; this would be dangerous and demoralising. According to Moy (1987, p.78):

> *'Maintenance of a correct posture is essential in order to achieve maximum performance as well as maximum well being.'*

2.7. Benefits to Design Theory

In this section I look at what the possible benefits to design might be as a result of this research. Allen (2002), in his PhD Thesis, makes a number of suggestions about the process of inclusive design within his review of his research and development of a communication device for people with sensory and physical impairments. The suggestions are centred on three themes; rapport, interviews and observation. He reports that there are a number of challenges for designers when generating understanding. Undertaking research into how to develop equipment for outdoor sport through field trials may help to add to the body of knowledge which is available to designers when working in fluid conditions. Involving both the coach and the designer may help to provide a deeper understanding for designers of how to watch and how to support the development of independent skills for the user, whilst at the same time developing sufficient understanding for the designer.

2.7.1. The Creation of a New Piece of Adaptive Sports Equipment for Disabled Adventurers

From a purely practical perspective, the physical 'design outcome' (the Active Back Support) of this work will enable disabled people with mobility or balance problems to access the sea kayaking environment more effectively. This design work has therefore enabled development of a range of opportunities at various levels of participation, from beginner to advanced athletes (see section 12.11). As a passionate canoeist and sea kayaker, being able to give back to a sport from which I have gained so much is of real personal significance.

In addition to these personal and practical reasons, there are a number of inter-related socio-economic design and sports development issues upon which this work has a positive effect. These are discussed in the next section. They relate to the way in which disability is seen in society as well as the way in which it is understood. Fuller (as cited in Papanek 1984, p.86) stated:

> *'You have to make up your mind whether you want to make sense or make money, if you want to be a designer.'*

In relation to Fuller's (as cited in Papanek 1984) words, this PhD is about making sense.

I would now like to focus on the positive effect of this PhD work on Inclusive Design. The work will help create an example of modular design, flexible enough to cater for the needs of people across the sports performance spectrum. From a sports design perspective, equipment for people with disabilities is often stigmatised and restricted to creating aids for daily living. For example, at the

2004 Cambridge Inclusive Design Conference (Keates et al 2004), there were no papers presented on Inclusive Design for sport. This may illustrate a lack of focus in design education, on the benefits, needs and methodologies of Inclusive Design for sport. A search of university courses involved in sports engineering reveals thirty-four courses over a spread of fifteen universities in the UK (Universities and Colleges Admissions Service 2006). With an emerging interest in sports engineering, this thesis presents a possible link between sports engineering and design and disability. This assertion was strengthened by MacDonald (2005, p.114) at the Include 2005 conference:

> *'In the first case, the main concern is to ensure that young design engineers understand sufficiently the dynamic diversity of the human-model for whom they are designing, that their process is sufficiently informed by user research, and that ultimately their products embody appropriate features and details to reflect this.'*

A positive outcome for this research must therefore be the development of tools and methodologies that make it possible for the next generation of designers to take on the development of appropriate solutions to help keep the current and next generation active regardless of disability.

2.8. Social Change

In this section I look at the possible outcomes for society when considering all of the paradigms for the research; disability, the outdoors, sport and design. Cultures change and each generation brings with it new experiences and new aspirations. New technology, materials and cultural aspirations make it possible for new goals to become reality, and for sectors of society to question their limitations and search for ways to realise new opportunities. Best (2006, p.158) stated:

> *'Design can and frequently does, play a role in contributing to environmental and social problems, but taking a responsible approach to design brings the opportunity to shape a more environmentally and socially aware future, and leads to valuable competitive advantage amongst an increasingly demanding and emotionally involved audiences.'*

Design links the aspirations of society to the functional environment. The role of design is to ensure that the needs of all in society are met within an appropriate technological framework which balances the social, cultural and environmental imperatives. Providing examples of inclusive outdoor design for use in challenging environments illustrates to those involved in design that it is possible to design items beyond the day to day needs of disabled people. This then suggests that disabled people can themselves live beyond the day-to-day. Design in this context is being used as a mechanism of social change. The important thing however is not just the intention or the dream, but the practical implementation of the design, i.e. the means as well as the social objective or imperative. Malone (1980, p.11) stated:

> *'An aid is a device, generally self- applied or managed, which by mimicking, substituting for, amplifying or monitoring a bodily function helps individuals maintain the gap between their aspirations and achievements at an acceptable level in the presence of physical or mental disabilities, particularly those that are socially as well as physically incapacitating.'*

Good inclusive design can challenge negative societal images by providing hard physical tangible evidence that inclusion is possible, as well as making sure that individuals have the ability to present the most positive image of themselves. This can be seen by the discussions at Include 2005, where various presenters including Underwood and Pullen, argued for the beauty in design to be maintained, to ensure that the cultural and social aspects often associated with fashion are not lost in the pursuit of inclusion. This is illustrated in Figure 15, which links design, development opportunity and social change. I see this as the beginning of a map for the role of design in society.

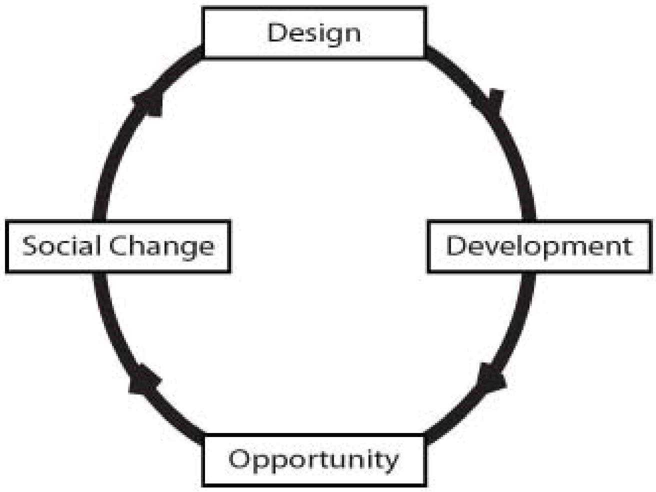


Figure 15 Design and Social Change

2.8.1. Changing the Image of Disabled People in Society

Berger (1972) suggests that the way in which we see ourselves is affected by the marketing and media images which are thrown at us in urban life.

One of the current social change models in Sports Development is the trans-theoretical model of behaviour change (Hylton et al 2001). From a therapeutic perspective, Prochaska and DiClemente (1983), a version of which is presented by the Cancer Prevention Research Centre (2004) in Figure 16, suggest a staged approach to the way in which individuals take up new opportunities or change their behaviour.

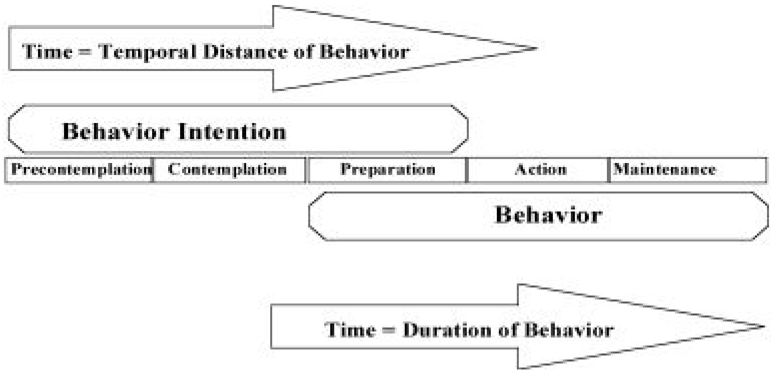


Figure 16 The Temporal Element of the Trans-Theoretical Model of Social Change (Cancer Prevention Research Centre 2004)

The components are defined as; pre-contemplation, contemplation, preparation, action, maintenance and relapse. Each of these is described in Table 9. It is from this staged perspective that I see the process of change for both the individual as well as for groups within society.

Table 9 The Elements of the Trans Theoretical Model of Social Change (Cancer Prevention Research Centre 2004)

Phase	**Activity**
1. Pre-Contemplation:	In pre-contemplation an individual will have no interest in opportunity and will not notice marketing of a new opportunity that may appear in newspapers, magazines or on billboards.
2. Contemplation:	Within the general population it is not unusual for people to spend up to six months at this stage. People at this stage are open to suggestion. They require support to review and reflect on their current lifestyle

Phase	Activity
	and how an opportunity could improve it.
3. Preparation:	This stage involves people taking the first steps towards an opportunity.
4. Action:	The first six months is absolutely crucial, as it is during this time that relapse is most common.
5. Maintenance:	People who start to enjoy an opportunity regularly will still need reminding of the many benefits and how achievement of their early goals has impacted on their lives. Plateauing and boredom can rapidly lead to relapse, so re-evaluation and further goal setting are vital.
6. Relapse:	Although relapse is extremely common and is best thought of as inevitable, positive interventions such as the IFI have shown that relapse is not the final result.

2.8.2. Changing the Image of Disabled People in Society

Considering Berger's perspective (our self-image is affected by media / marketing) alongside the trans-theoretical model of social change (TM), as shown in Figure 17, and relating it to the role of design and development in social change, it is possible to see that designing equipment is arguably the strongest catalyst for the development of sport and sporting opportunities. Good design creates the right image, which inspires confidence and leads to the take-up of opportunities.

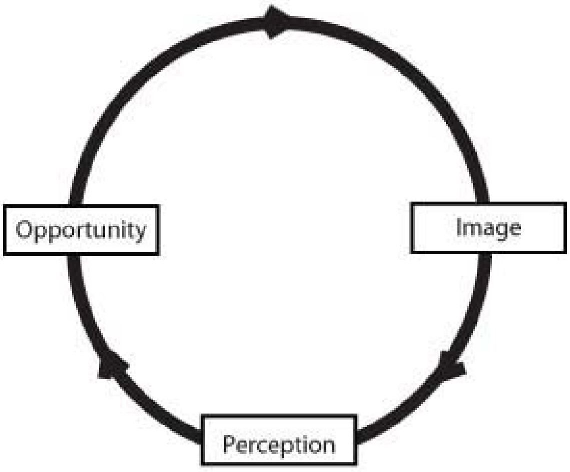


Figure 17 The Link between Berger and the Trans theoretical model of social change

As a designer wishing to discover the success of a piece of sports equipment, it is important to understand this social context, as it helps to define the relevance of any data or feedback from the user.

It is possible to see from the model that the image which good design creates, challenges the perception of both the user and society (Berger 1972).

This is further substantiated by the Cycle of Oppression (Ward et al 2005), shown in Figure 18, a common model used in disability and equality training. The cycle illustrates how image and stereotype lead to prejudice and attitudinal barriers, which collectively can restrict participation in a desired activity. If unchecked, this downward trend can lead to negative legislation and ultimately affect the environment in which society operates.

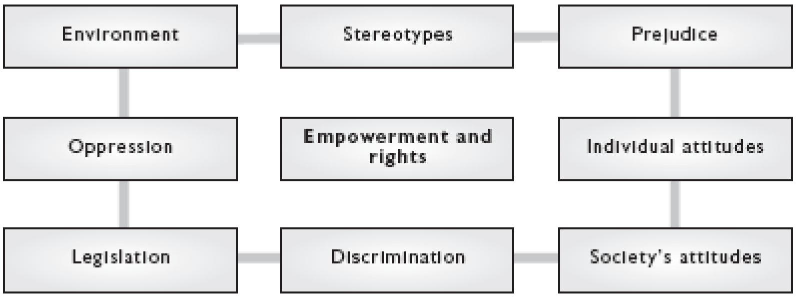


Figure 18 'The Cycle of Oppression, Ward et al (2005)'

One of the common ways in which disabled people are presented is as passive consumers or followers of those who provide for them. Creating resources which empower disabled people to go out and challenge this passive image is vital to ensure that positive social change can occur.

This PhD work has active applications which help to foster a more dynamic image of what disabled people can do. Providing designed sports equipment solutions for people with disabilities challenges stereotypes and changes images of disabled people. This can help to overcome negative attitudinal barriers often presented by society.

In sport, attitudes of disabled people, coaches and clubs can also be challenged through design. Developing equipment helps to raise the standards and expectations of both users and providers. Providing appropriate equipment adds weight to the way in which inclusive sport is perceived, setting new precedents for what is possible both in design and in terms of role models.

2.9. The Inclusive Fitness Initiative (IFI) - A Multi-Disciplinary Approach to Creating Opportunities for Disabled People Through Social Change in Sport

A UK example of an initiative seeking to remove barriers faced by disabled people in fitness is the IFI. The IFI, launched in January 2001, is overseen by the English Federation of Disability Sport, and run by Montgomery Leisure Services on behalf of the combined funding and management group. The national (English) initiative is funded by the Sport England Lottery Fund, in partnership with local authorities and not-for-profit organisations. Paul and Hughes (2004, p.336) state the key elements of the IFI as being:

- Equipment – Partnership funded upgrades for existing or new-build gyms.
- Training – Support for gym instructors and facility staff by the provision of training and resources.
- Marketing – To ensure that disabled non-gym users are appropriately informed.
- Sports Development – To ensure that elements are presented cohesively.

If one compares the IFI to current social change models in Sports Development mentioned earlier, such as the TTM (Prochaska & DiClemente 1983), then it is possible to see that the IFI works at a range of levels to ensure that a non-user of a fitness facility is supported through their change into an independent gym user. Marshall and Biddle (2001, p.229) go on to suggest that the TTM requires further evaluation with regard to physical activity:

> *'Finally, the role of processes of change needs re-examining because the higher order constructs are not apparent in the physical activity domain and stage-by-process interactions are not evident. There now are sufficient data to confirm that stage membership is associated with different levels of physical activity, self-efficacy, pros and cons, and processes of change.'*

A potential result of this research would be to strengthen the understanding of the relationship between design, sporting opportunity and sporting structures, thus rallying to Marshall and Biddle's (2001) call.

2.10. Chapter Conclusion

This chapter has focused on the rationale for this PhD, and discussed the importance of creating real practical choices and developing access to sport and the outdoors for disabled people. I have discussed how to challenge negative images of disabled people to empower social change.

In conclusion, I believe that my work is important as it challenges all elements of the Cycle of Oppression (see Figure 18). My work engages strongly with elements of social change, and recognises that design is the ideal catalyst for this change, providing three dimensional objects which are solid representations for people's dreams. The complex interplay of sociological, legislative and design-based development is a compelling focus for a PhD study. However, as a designer I have chosen to focus this PhD on a practical outcome which helps to meet some of the broader social and legislative needs of disabled people and the outdoor industry. The work will focus on the development of a postural support system for physically disabled, intermediate-level sea kayakers, creating a practical, tangible product as an outcome.

3.

Chapter 3

A Review Of Current Practice and Understanding of; Paddlesport Performance, Sea Kayaking Environment, Issues Surrounding Spinal Cord Injury, Postural Stability Coaching Practice, Seating Metrics, Water Safety and Current Design Solutions

3.0. Chapter Introduction

In section 3.1 I review the current understanding of paddle sport, kayak performance, and the sea kayaking environment. The functional understanding of spinal cord injury (SCI) is considered in section 3.2. Seating, posture and coaching performance considerations are outlined in section 3.3. The outdoor equipment market, mobility equipment, seating design, the material of tissue viability and the anatomy of kayak design is mapped in section 3.4, which provides many of the design parameters for the forthcoming iterative design process. Section 3.5 considers attitudes to safety as well as practical design themes, this section adds to the ethical framework for the research, asking designer, participant and coach what is reasonable risk. Current solutions and activists in the area are considered in section 3.6. The Chapter therefore forms the technical basis of the research and design criteria outlined in Chapter one.

Much of the reference materials for this section comes from the paradigm of paddlesport. The references are therefore taken from top practitioners. In the absence of a peer review structure which underwrites academic knowledge, I have used two criteria for selection of pragmatic reference material; accreditation or publication by the National Governing Body of the sport, the British Canoe Union (BCU) and the author's credibility as a practicing coach.

The conclusions and key themes from this chapter, the preface, Chapter one and two are brought together in Chapter four to form an outline brief and specification for the forthcoming iterative design process and a set of themes for investigation during the remainder of the research. This chapter can therefore be considered as a springboard for the planning of the data collection and design elements to the research. Issues to do with fieldwork are dealt with separately in Chapter five. Methodology is presented in Chapter six.

3.1. Paddle Sport

Section 3.1 details current understanding of paddlesport performance, to create a model of good kayaking. This provides a benchmark for the further understanding of the performance characteristics of kayak athletes with spinal cord injury. Tracing the history of paddlesport in Britain, Good et al (1989) suggest that there are three core components, regardless of the discipline: body, boat and blade or paddle. Good et al (1989, p.1) suggest:

> *'The modern canoeist or kayakist enjoys the primitive battle with a hostile environment, equipped only marginally better than his ancient forebears.'*

It is from this historical meta-view of paddlesport that I begin my understanding.

This meta model of paddlesport has been further developed in the re-write of the British Canoe Union's Handbook (Taylor 2006). The original model has been expanded to include a whole performance perspective, as shown in Figure 19 (Taylor 2006). It is from this more holistic stance that I see the activity of canoeing and kayaking and suggest this as the framework for the understanding of the activity of kayaking for the purpose of this research. This holistic approach helps to place any information exchange or feedback between coach and performer into context.

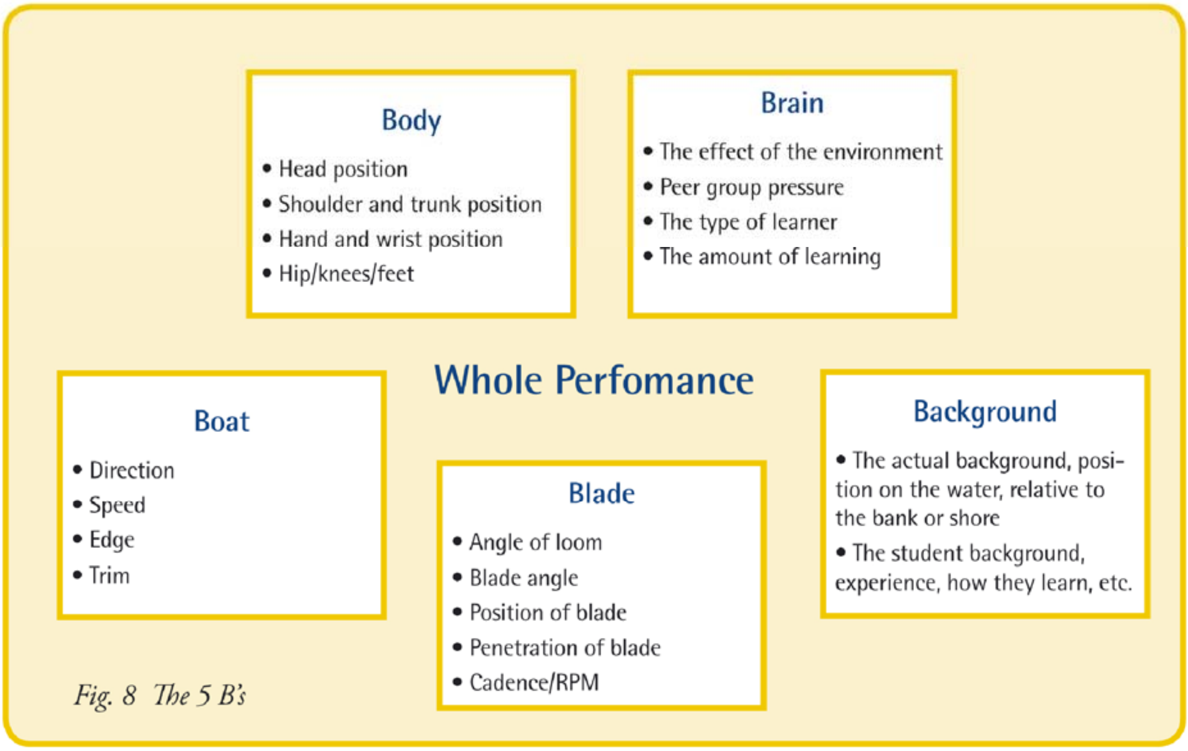


Figure 19 Body, Boat, Blade, Brain and Background, Taylor (2006, p.29)

Goodman (1989, p.28) suggests that the design of a canoe or kayak is a compromise between a number of factors, most often to achieve a given task in a varying set of conditions:

> *'speed and maneuverability are mutually incompatible, as are other subtle aspects of performance; thus a canoe or kayak must, of necessity, be a compromise.'*

Goodman (1989, p.28) goes on to suggest that due to the nature of the performance environment, most boats are designed through experience:

> *'Further, canoes and kayaks are asked to perform under a wide spectrum of conditions, and worse these are often of a very turbulent nature. This means that normal mathematics which can be applied to problems of performance will often give unsatisfactory results. Most*

designs, therefore, are the result of experience and intuition – not necessarily any worse for that, but very often the stated performance becomes a matter of extravagant subjective claims rather than objective reality.'

Goodman's (1989) assertion provides an interesting problem for the designer, which I explore in more detail when I consider the approach of the studies and the subsequent methodology. The need is to capitalize on the experience of the performer and coach, the intuition of the designer, whilst at the same time balancing influences from other data sources.

Campbell (2006) explains the relationship between the boat, water and paddler further, suggesting that: 1) support when paddling comes from the water, 2) there are four connections with the water in the boat; two feet and two buttocks, and the paddle outside the boat, 3) the body needs a stable support in order to paddle vigorously, 4) the harder the kayaker paddles the more support is required. This defines the mechanical linkages in the paddling system and is where I start my understanding.

Cox (1992, p.32) quantifies the body's role in the kayaking system as follows:

'The buttocks should be placed comfortably into the scoop of the seat, against the back of the seat. The distance between the seat and the footrest should be such that when the arch of the foot is placed against the footrest, the legs are almost fully extended at the knees. When the ball of the foot is placed against the footrest, as it should be during paddling, the legs should have a flex of approximately 160 degrees at the knees. Too much bend of the knees can interfere with breathing and rotation of the torso.'

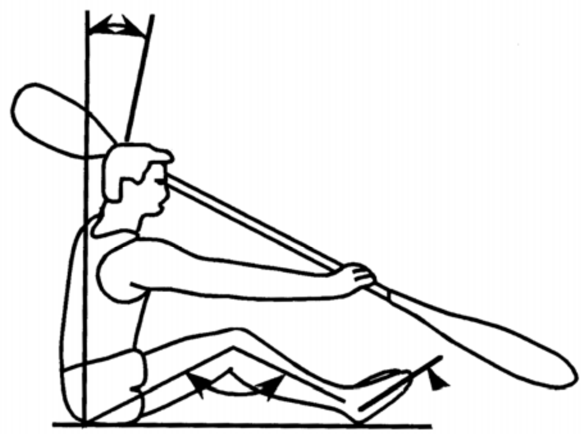
	**Body Component** Forward Lean Knee Flexion Ankle Plantarflexion	**Ideal Angle** 5-10 120-130 40-50

Figure 20 Seating Position, Campbell (2006, p.207)

Cox (1992) provides a start point for understanding the basic sitting position for kayaking, and provides a base line for the development of adjustments within the seating system. Campbell (2006, p.207) in Figure 20 provides a graphical representation of the ideal seating position for the kayaker.

Cox (1992), Ferrero (2002) and Goodman (1989) together provide a model for the kayak seating designer, suggesting that the key interaction between the performer and the kayak consists of the buttocks, lower back and knees, with a set of angles between body segments which need to be maintained. Additionally, the support from the paddle blade should not be underestimated.

3.1.1. Understanding Basic Paddling Techniques

This section provides an overview of the types of strokes available in paddlesport. It moves on to look in more depth at the process of propelling a boat forward efficiently as a start point for the understanding of what efficient paddling could be. The aim here is to provide a framework for the understanding of the key performance criteria placed on the athlete during their performance in a sea kayak.

Edge (2006) suggests in his analysis of basic slalom technique for coaches, that the key ways in which the performer's stroke can influence the moment of the boat with the blade are by; pulling the boat past the blade, pulling the boat towards the blade, push the boat away from the blade. Figure 21 suggests the common patterns of strokes.

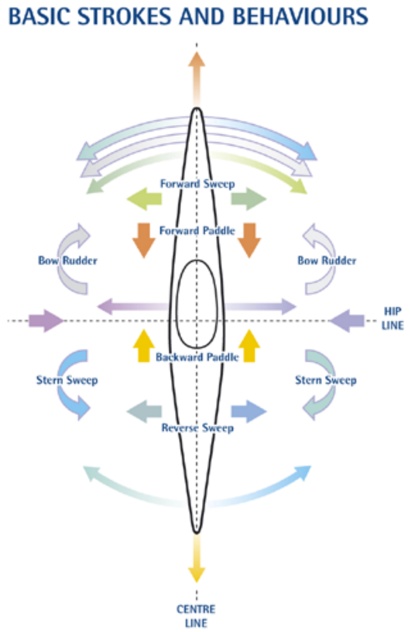


Figure 21 Basic Strokes and Behaviours, Morris (2006, p.330)

The stroke patterns clearly suggest that the paddler needs to generate force in all quarters. Any seating solution is therefore required to transmit the force generated by the action of the paddler's body and blade to create functional controlled movement of the kayak.

3.1.2. Forward Paddle Stroke – Understanding the Internal Forces within the Paddler, to Model Postural Support Requirements

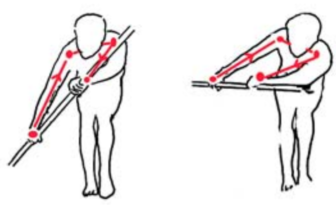
I now look at the concept of moving the boat forward in terms of the forces placed on the body. Campbell (2006) given in Table 10 suggests that the forward kayak paddle stroke can be broken into three phases: plant, drive and exit.

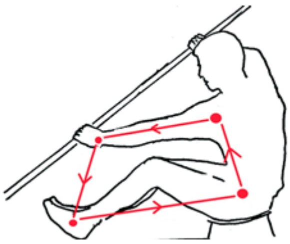
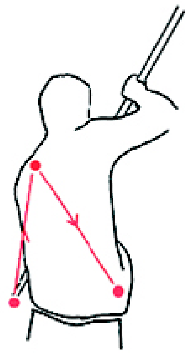
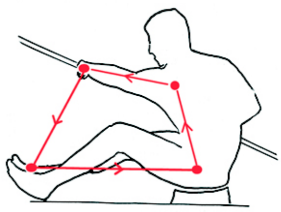
Table 10 Analysis of Forward Paddling, based on Campbell (2006, p.205-216)

Phase	Action	Objective
Plant	Paddle is driven into the water in front of the body, as far forward as possible using the power of the whole body To create as much space for the paddle stroke as possible	
Drive	Stability is given from the legs, pressing on the footrest. Strong upright posture in the body. Whole body slides the boat past the paddle. Blade remains stationary	Maintain the direction and flow of the stroke, with force throughout Large muscle groups generate power Body unwinds to generate power
Exit	Blade removed from water before hip	Maintains forward speed Maintains stroke cadence

Campbell (2006), shown in Table 11, suggests the concept of five power circles, to show how forces are resolved through the body, boat and blade system during the three phases of the stroke. Understanding these forces and comparing them to the underlying physiology will provide a basic set of criteria for the structural elements to the postural support. The systematic analysis of forward paddling suggests that there are five key sets of forces which need to be resolved within the body to achieve efficient forward paddling. This model is used later to consider the relationship between the performer and the equipment.

Table 11 Summary of Power Circles - Analysis of Forward Paddling (Campbell 2006, p.209-216)

NO	Name	Key Principles	Diagram
3	The Basement of the Stroke – Legs and buttocks.	Forward Paddling built on support of the water. Body connected to the water by the feet/ footrest and the bottom of the seat. Firm connection between the hip and boat as the foot presses on the footrest. Provision of a firm base for the stroke.	
2	Body Rotation – The trunk rotates.	Whole body movement. The trunk rotates on the firm base provided by the legs and the pelvis. Whole structure rotates as one, keeping an upright	

NO	Name	Key Principles	Diagram
		posture. Arms connect the trunk to the paddles but do not work independently. Connection between shoulders and the paddle blade, from shoulder to shoulder.	
1	The Catch – The lower arm is straightened and the paddle is driven down into the water in front of the cockpit using the power of the whole connected trunk.	Paddle becomes fixed in the water to move the boat past.	
4	Move the Boat past the blade – The blade is locked at the catch and the opposite hip drives the boat forward as the trunk unwinds powerfully against this fixed point.	Slide boat past paddle. Connection with blade in water and opposite hip. Hip blade connection maintained throughout the stroke.	
5	Top Arm Connection – The top arm is pushed forward and the trunk rotates but remains connected to the movement of the trunk structure.	Connection between the stroke side foot and the opposite (top) hand, compressing the paddle shaft. Keep top arm as part of trunk structure.	

I see the skill of forward paddling in this context, and suggest that the concept of power circles provide a basis for the understanding of the forces applied through the boat, body, blade system. It is clear that the forward paddle stroke requires rotary forces to be changed into linear movement of the boat. I suggest that successful support of forward paddling is a key indicator of successful postural support design within the context of sea kayaking.

3.1.3. Sea Kayaking

Brown (2002, p.245) suggests that wind and waves are key external factors for the sea kayaker:

> *'The dominant forces acting on a sea kayak are wind and wind generated waves. A kayak should move forwards and track in a straight line. Constant corrections to keep the boat on course waste energy and could be used to keep the boat moving ahead, and reduce the distance travelled for the energy expended.'*

This implies that the art of good sea kayaking is efficiency of energy expenditure.

Goodman (1989) suggests a model of the forces applied to a kayak as shown in Figure 22. This provides a framework for understanding the external forces applied by the environment on the kayak. It is from this standpoint that I consider key forces which act on the boat during the performance of a given task.

These forces are also a framework for feedback to the performer and the mechanical characteristics of the performance environment. This framework provides a start point for my understanding of the task and the performance environment in order to provide a platform for future design development.

Term	Thesarus
Lateral stability	1. Tippiness, 2. Stability, 3. Capsize, 4. Rolling, 5. Eskimo roll, 6. Heeling, 7. Snatching
Longitudinal stability	1. Looping, 2. Pitching, 3. Purling, 4. Lifting, 5. Buoyancy, 6. Trim, 7. Displacement, 8. Fitness, 9. Balance
Directional stability	1. Turning, 2. Steering, 3. Yawing, 4. Change of direction, 5. Manouverability, 6. Balancing, 8. Feel

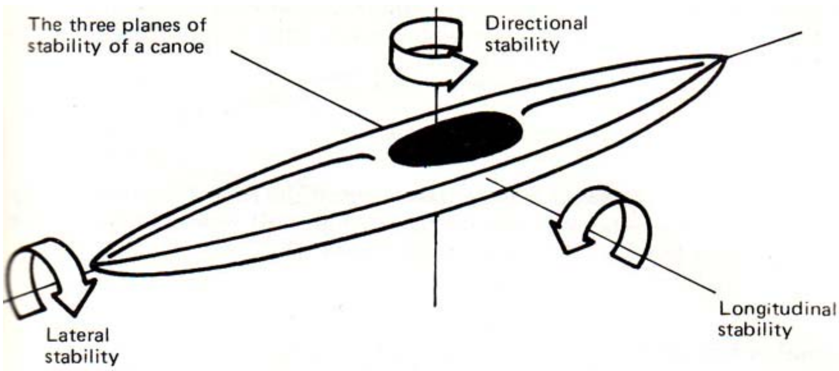


Figure 22 The three planes of stability of a canoe (Goodman 1989, p.33)

I now look at the nature of the performance environment in terms of boat manoeuvring. Morris (2006) suggests that sea kayakers require the following physical skills; good boat awareness, good forward paddling in various conditions, close quarter manoeuvring skills, rough water handling skills, skills for launching and landing, skills to rescue others, rolling and self rescue skills.

Figure 23 Sea Kayak Environment/Conditions (Morris 2006, p.252) provides a model of the sea kayaking environment by Morris (2006). With this, she provides an ideal structure for the designer to understand the basics of the performance environment. At first glance the model reveals three key elements; coping with environmental factors, boat handling, and launching and landing.

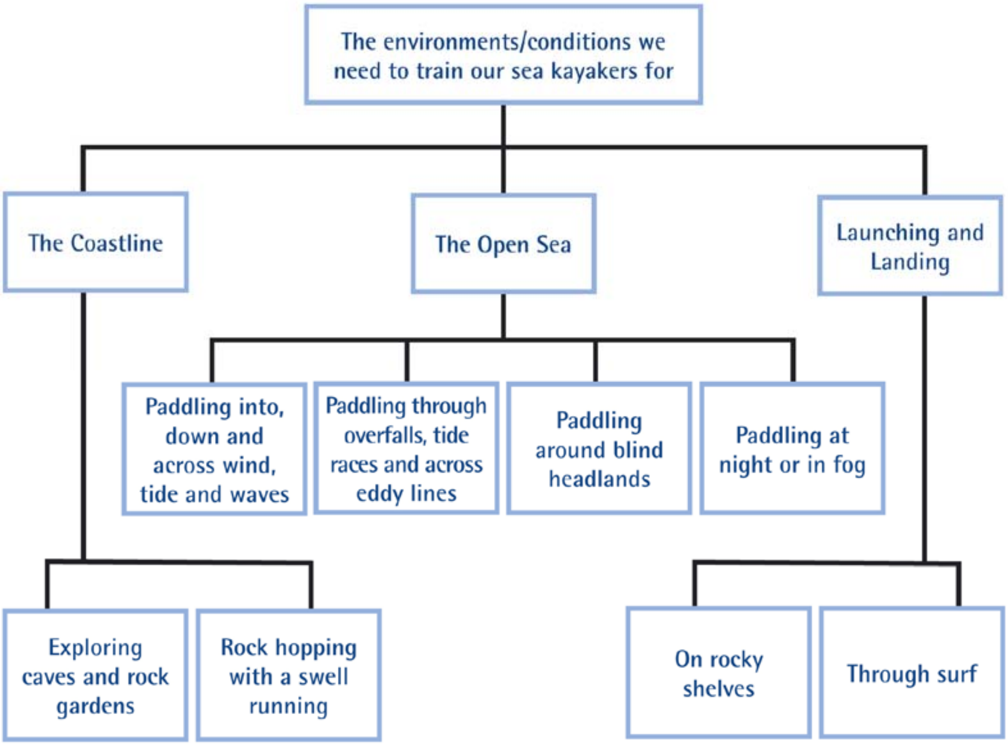


Figure 23 Sea Kayak Environment/Conditions (Morris 2006, p.252)

3.2. The Performer – The Current Understanding of the Performer with Spinal Cord Injury

In this section we look at the way in which it is possible to further classify the physiological consequences of spinal cord injury to strengthen the functional understanding of the needs of the athlete. A greater understanding may also improve the quality of the interactions between design researcher and athlete during the iterative design process.

Spinal Cord Injury (SCI) has been defined by those studying the effects of kayaking on the sitting balance of athletes with SCI, such as Grigorenko et al (2004, p.110) as:

'Spinal cord injury (SCI) means an abrupt cessation of normal neuromuscular function. Both descending motor tracts and ascending feedback pathways are interrupted. The degree of functional loss depends on the level and completeness of spinal lesions. Lesions below cervical level cause paraplegia i.e. paralysis involving the lower extremities and the trunk. Individuals who have suffered SCI are forced to spend most of their time in a wheelchair and thus to perform their daily living tasks in a sitting position.'

Although I agree broadly with the tenet of their definition, I would prefer to use a more positive interpretation. I recognise that it is not my role as a designer to identify suffering; my role is merely to solve practical problems.

3.2.1. Practical Physiological Issues Surrounding Spinal Cord Injury

Practical physiological issues are important to the designer as they identify many of the criteria which need to be considered as part of the design process. Following a strong reminder to ask the athlete about their needs, Goodman (1995) outlines a range of practical issues for the seated performer, as summarised in Table 12. I consider these criteria as a framework for both issues concerning design and the foundation of a field safety protocol.

Table 12 identifies the key issues to be considered are; range of motion, protection of skin and skeletal structures and avoidance of sensitive areas. Additionally the need to understand the symptoms of autonomic dysreflexia and urinary tract infection need to be considered during fieldwork. From a design perspective, pressure sore protection or maintaining tissue viability is a key issue which requires further attention.

Table 12 Considerations for an Athlete with SCI (Goodman 1995, p.98-104)

Issue	**Summary**
Temperature Regulation	Loss of ability to perspire below level of injury, resulting in overheating or hypothermia
Poor Circulation	Resulting in blood pooling in the lower limbs, light headedness
Decreased Range of Motion	In joints which are no longer actively used
Decreased Flexibility	May have steel rods in spine to correct scoliosis or provide spinal stability
Hypertrophy Induced Muscle Imbalance	Over development of front of deltoids and pectorals. This can lead to shoulder girdle problems
Pressure Areas (Sores)	Prone to pressure sores because of lack of sensation, movement, circulation and muscle tone/function
Bowel and Bladder Control	'Special Apparatus' for bladder control; catheter, colostomy bags, permanent or intermittent
UTI	Can change suitability for participation along with other low grade infections
Lack of Sensation	Unknowing damage to skin and other tissues below level of lesion
Poor Balance	Resulting from lack of sensation and muscle paralysis
Autonomic Dysreflexia (Hyperflexia)	Affects athletes with lesions of T6 and above; triggered by bladder over-distention or other painful or noxious stimuli. Results in high BP, sweats, chills and in extreme cases stroke or death

3.2.2. Tissue Viability and Seating for Sport

In this section I consider tissue viability when applied to seating. Issues surrounding skin care are explored, to inform a design specification for application later in the research. According to Cochran and Palmieri (1980, p.9):

> *'Prevention of decubitus ulcers continues to be one of the primary problems confronting rehabilitation engineers. One vital aspect of this subject concerns the design, selection, and evaluation of wheelchair cushions to reduce tissue trauma in the seated patient, particularly those with spinal cord injuries.'*

From a practical perspective, I take the summary given in Table 13.

Table 13 Summary of Tissue Viability (University of York 1995, p.2)

Grade 1	Discoloration of intact skin, including non-bleachable erythema, blue/purple and black discoloration.
Grade 2	Partial-thickness skin loss or damage involving epidermis and/or dermis.
Grade 3	Full-thickness skin loss involving damage or necrosis of subcutaneous tissues; but not to the underlying bone, tendon or joint through the underlying fascia and not extending capsule.
Grade 4	Full-thickness skin loss with extensive destruction, and tissue necrosis extending to the underlying bone, tendon or joint capsule.

Guimaraes and Mann (2003) suggest that the key factors causing a pressure sore are; pressure under bony prominences, shear forces, temperature, moisture, nutrition, seating position and daily life routine. They state that the ischial tuberosities receive the highest pressure when a person is in a seated position.

Cochran and Palmieri (1980) suggest that client acceptance of wheelchair cushioning and clothing should also be considered as part of skin management.

For the seating designer understanding this is vital, as there is a conflict between the need to provide a firm interface between the boat and the performer and the need to provide a level of skin protection suited to the adapted physiology of the athlete with SCI.

3.2.3. Classification of Spinal Cord Injury

SCI can be sub-classified in the following way depending on the amount and nature of spinal cord damaged and the height of injury in the spine; coccyx, lumbar, thoracic, cervical. According to the International Spinal Research Trust (2006), in a complete spinal cord injury, the spinal cord is damaged across the whole width, so that there is no function below the site of injury and both sides are affected equally. In an incomplete injury some areas remain intact, so that there is some sensation and/or movement below the site of injury. Both sides are rarely affected equally.

Table 14 Overview of SCI - Clinical Diagnosis Based on Roulstone (2003)

Level of Spinal Lesion	**Overall Functional Outcome**
C4	Tetraplegic
C6	Tetraplegic
C7 - C8	Tetraplegic
T1 - T4	Paraplegic
T5 - T9	Paraplegic
T10 - L1	Paraplegic
L2 - S5	Paraplegic

The level of injury can also be classified in terms of the functional outcomes for an individual following SCI, as shown in Table 14.

Additionally it is the identification of the functional elements which are of interest in terms of fully understanding the nature of the performer with SCI. Roulstone (2003) identifies these as; mobility & movement, respiratory system, personal care, domestic care and communication.

Blackwell et al (2001, p.5), suggest that the Asia Impairment Scale has been broadly accepted as the common measure of SCI. The key elements of the system are summarised in Table 15.

It is clear that there are both movement and sensation implications to SCI. For the designer this presents a range of issues that need to be considered in terms of the structural and material performance of a design.

This sub classification of SCI helps to identify the additional design criteria and to create a clear picture of the functional needs of the performer. This may influence their performance and choice of the postural support system.

Alternatively we can see SCI in purely functional balance terms and seek to understand the balance available to the performer. According to Weiner et al (1993 p.786), The Functional Reach Test (FR) provides a protocol for measuring the balance available to an individual:

> *'FR represents the maximal distance one can reach forward beyond arm's length (in a horizontal plane), while maintaining a fixed base of support in the standing position. It was conceived because of our desire to create a clinical measure of balance that is reliable, clinically valid*

across a wide range of physical performance, easy to implement, and sensitive to change over time.'

Table 15 Asia Impairment Scale, from American Spinal Cord Injuries Association (2007)

Metric	**ASIA Impairment Scale**
A	Complete: No motor or sensory function is preserved in the sacral segments S4-S5
B	Incomplete: Sensory but not motor function is preserved below the neurological level and includes the sacral segments S4-S5
C	Incomplete: Motor function is preserved below the neurological level, and more than half of key muscles below the neurological level have a muscle grade less than 3
D	Incomplete: Motor function is preserved below the neurological level, and at least half of key muscles below the neurological level have a muscle grade of 3 or more
E	Normal: Motor and sensory function are normal
Metric	**Muscle Grading**
0	Total paralysis
1	Palpable or visible contraction
2	Active movement, full range of motion, gravity eliminated
3	Active movement, full range of motion, against gravity
4	Active movement, full range of motion, against gravity and provides some resistance
5	Active movement, full range of motion, against gravity and provides normal resistance

Metric	ASIA Impairment Scale
5*	Muscle able to exert, in examiner's judgment, sufficient resistance to be considered normal if identifiable inhibiting factors were not present

Lynch et al (1998) suggest that modified functional reach tests are appropriate for people who cannot stand.

They also define 'face validity' as the ability of a test to measure something specific, suggesting that the performance of an individual during the Functional Reach Test can be affected by their motivation (1998, p.132):

> *'Better performances may occur when patients are challenged appropriately by a test and poorer performances occur when patients believe that the test has no meaning for their problem. Face validity seems to be present in the modified FR test because subjects felt the challenge to their stability and had to make a great effort not to fail or a fall would occur.'*

Considering this approach it is important for the designer to embed their test of stable balanced posture within an activity that motivates the athlete. Coaching optimizes athlete motivation. I suggest that to achieve a valid, accurate, reproducible test, control of the motivational variable must be embedded within the test. A coaching process should therefore be employed alongside any test.

3.2.4. Core Stability for the Kayak Athlete and Equipment

In this section I develop a theoretical model of the performance of kayakers with spinal cord injury (see section 3.2.12), to develop a better understanding of the problem to be solved, as well as to better understand the relationship between the athlete's performance and the equipment. Literature searches reveal little on the study of athletes with SCI participating in kayaking.

There is also little data concerning the postural mechanics of non-disabled kayak athletes. There is data on the action of core stability on the performance of non-disabled kayak athletes. I therefore consider this to create a base-line for the generation of a model of kayaking for non disabled athletes before then utilizing it as a baseline for the assessment of kayakers with SCI.

I consider the nature of the performer in terms of what is good posture and stability and how components of standard equipment resolve the forces within the kayaking system.

When considered in a rehabilitation context, stability is reported to be essential for performance of daily living tasks. According to Aissaoui et al (2001 p.274):

> *'Dynamic sitting refers to the continuous process of postural changes during sitting. Sitting posture is usually unstable without additional external support because the hip joints are in an intermediate position with respect to the range of motion and because the trunk cannot be locked relative to the thighs by ligamentous restraint. As a result, muscle activity is necessary to maintain the trunk segment in an upright posture when sitting without additional stabilizers. The capacity to maintain balance and posture in sitting is a prerequisite to the activities of daily living (ADLs), and deficits in sitting balance control can severely limit task performance.'*

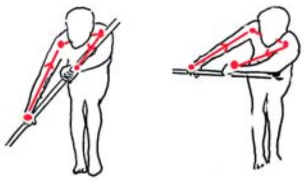
Stability therefore provides the nexus for: kayaking posture, SCI posture and elements of the mechanical model of kayaking, described previously as power circles. There is also a link between stability and optimal performance; creating stability for the performer must be a key performance indicator for the success of any design solution in this research. Elphinston (2005) defines stability in a paddlesport context as the ability of the body to withstand, support and generate forces with optimal efficiency and minimal musculoskeletal stress.

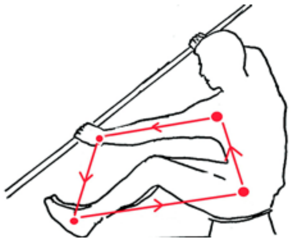
Elphinston (2005) goes on to suggest the likely ways in which failure in any of the power circles can affect performance. The role of equipment in supporting good posture is considered later in this chapter. Table 16 provides a start-point for understanding the nexus between task (or sport), performer, and equipment.

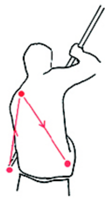
Table 16 Power Circles and Core Stability – Presented from the base up.

Power Circle **(No. 1)**	
Name/ Description	The Basement of the Stroke – Leg and buttocks
Key Principles	Forward paddling built on support by the water
	Body connected to the water by the feet/ footrest and the bottom of the seat. Firm connection between with the hip as the foot presses on the footrest. Provision of a firm base for stroke.

Technical Perspective	A weak leg drive means a loss of connection between the footrest, the hip/seat, the boat and the water. There is no base to build the paddling upon.
Physical Perspective	The legs should push the pelvis into rotation. Two elements are necessary. The pelvis must have the mobility to rotate The muscles which connect the thigh and the pelvis by crossing the hip must secure the joint so that the force of the leg is transferred effectively to the trunk. Good functioning of the gluteus maximus and gluteus medius is essential.

Power Circle (No. 2)	
Name/ Description	Body Rotation – The trunk rotates.
Key Principles	Whole body, the trunk rotates on the firm base provided by the legs and the pelvis. Whole structure rotates as one, keeping an upright posture. Arms connect the trunk to the paddles but do not work independently. Connection between shoulders and the paddle blade, from shoulder to shoulder.
Technical Perspective	The Upper body structure breaks up, arms bend, the shoulder/trunk area cannot hang onto the catch. Push/pull paddling is often the result.
Physical Perspective	To maintain power circle 2, several elements are necessary. A strong neutral trunk position. If the trunk is collapsed, it pushes the shoulder girdle forward and upwards. This makes it impossible to use the shoulder stabilizers effectively. A stable upper zone. This upper zone is the shoulder girdle, and lower trapezius and serratus anterior are the main muscles involved in stability of your shoulder blade. The shoulder blade (scapula) must be stable to transfer forces from the arm to the trunk. Trunk rotation. If there is insufficient trunk rotation, the force from the arms has nowhere to go.
Equipment Perspective	Integrity of the paddle shaft, and upper girdle of the performer. Power circle 3 (muscles of the trunk) forming the base of support.

Power Circle **(No 3)**	
Name/ Description	The Catch – The lower arm is straightened and the paddle is driven down into the water in front of the cockpit using the power of the whole connected trunk.
Key Principles	Paddle becomes fixed in the water to move the boat past.
Technical Perspective	The shoulder arm connection is not secure, the catch cannot be locked, the paddler is not able to hold connection between blade, shoulder, hip and footrest.
Physical Perspective	A combination of upper and lower body elements may be at fault.
Equipment Perspective	Back rest, foot rest, trunk, arms and paddle shaft.

Power Circle (No.4)	
Name/ Description	Move the Boat Past the Blade – The blade is locked at the catch and the opposite hip drives the boat forward as the trunk unwinds powerfully against this fixed point.
Key Principles	Slide boat past paddle. Connection with blade in water and opposite hip. Hip blade connection maintained throughout the stroke.
Technical Perspective	The paddler cannot apply the power and move the boat as there is a breakdown in the connection between the blade and the opposite hip. The boat rocks away from the catch.
Physical Perspective	To prevent this problem, the paddler must have a secure trunk. If it is collapsed into a slump, it will be difficult to stabilise the pelvis in a side to side direction (the coronal plane). If they cannot rotate their pelvis, their movement will be shifted into the alternative plane of movement allowed by sideways collapse of the pelvis.
Equipment Perspective	Trunk muscles supported by the basement of the stroke (3).

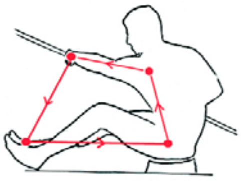
Power Circle (No. 5)	
Name/ Description	Top Arm Connection – The top arm is pushed forward and the trunk rotates but remains connected to the movement of the trunk structure.
Key Principles	Connection between the stroke side foot and the opposite (top) hand, compressing the paddle shaft. Keep top arm as part of trunk structure.
Technical Perspective	The Top arm becomes disconnected from the whole body structure and flies upwards out of control. The trunk wriggles and connection is lost between boat and upper body. Shoulder, balance and trunk control problems could contribute to this.
Physical Perspective	As 1 rotation will involve 4.
Equipment Perspective	As 1 rotation will involve 4.

Table 16 identifies the equipment elements and physical elements that need to be considered. The key equipment elements are; foot rest, under deck, thigh braces, seat, backrest and paddle. The physical elements are; legs, pelvis and trunk, and upper girdle. The most complex rotational forces are those involving trunk rotation, which directly demand core stability. I therefore propose to look at core stability in more detail before moving on to look at the equipment implications.

3.2.5. Understanding the Mechanics of Core Stability

In this section I explore the mechanics of the spine from the perspective of functional core stability. I identify how the spine functions from the perspective of a fully functioning movement, to form the basis for modelling active posture for spinal cord injury. A model of core stability for the seating designer is presented in Section 3.2.12.

I start with the assertion from Norris (2000, p.12), that poor postural control leaves the spine vulnerable to injury:

> *'Devoid of its musculature, the human spine is inherently unstable. The spine of a fresh cadaver, stripped of muscle can sustain a load of only 4-5 lb. [……] thus spinal stabilization can be considered a dynamic balancing act.'*

By making the assumption that there is little or no support below the level of injury makes it possible to create a clear design brief. Taking the worst case scenario makes it possible to create initial solutions which can be pared down by removing structural elements of a design. This is often more effective than adding a new element or adding strength later. Understanding natural movement and support structures makes it possible to create a design solution that is sympathetic to the natural movement of the spine.

3.2.6. Natural Spinal Movement – Stabilising Neutral Movement

Norris (2000) states that the individual vertebrae of the spine act in groups of three, known as segments. Neutral zone of spinal movement is the vertebral displacement before resistance is offered, suggesting that control of neutral movement is the key aim of postural rehabilitation. For the designer the neutral zone provides a datum, a range of movement that should be maintained but not increased or decreased as a result of poor postural control.

3.2.7. Sacro Illiac Joint – A Firm Base of Support

The interaction between the pelvis and sacrum forms the sacro-iliac joint (SIJ). The keystone arrangement between both structures has a dynamic relationship, with flexion, extension and rotation of the trunk creating associated movements in the SIJ (Norris 2000).

3.2.8. Three Systems of Back Stability – Passive, Neutral and Active

According to Norris (2000), spinal stability is created by three physiological systems; passive (ligaments), active (contractile tissue), and neutral which control the sensory feedback.

The active system has two components; the deep, thoracolumbar fascia and the superficial, muscles of the trunk. Norris (2000) goes on to suggest that without support, the active tissues of the spine become vulnerable to injury.

A person with SCI will have passive spinal stability but will have loss of active and neutral function. I therefore focus on the action of the passive and active elements of core stability both independently and interdependently. I see that feedback concerning body position for the SCI athlete may not come directly from the seating system (which must in some way replicate the function of the active and neutral systems), but also from the passive system which may remain intact.

3.2.9. The Passive Support System

The passive ligamentous system includes the visco-elastic action of the posterior ligaments of the spine. The intervertebral discs act as spacers to the natural form closure between the vertebrae and their articulating surfaces, including the interaction between the pelvis and sacrum. In addition the action of intra-abdominal pressure as maintaining the natural arch of the spine is also considered.

The inert posterior ligaments create a passive braking system for the spine but provide little strength to the structure if they are not manipulated by muscular contraction. The four ligaments of the spine; flavium, interspinous, supraspinous and intertransverse, link to the thoracolumbar fascia, which forms a connection with the deep abdominal muscles to create an active method of spinal stabilization outlined later.

The individual synovial joints have articulating surfaces, articulating cartilage, and intervertebral discs which act as spacers for the interlocking articulating surfaces of the vertebrae. The discs react under axial loading of the spine (Norris 2000). I argue that the detail of this component is not a vital to this study, as none of the forces created while kayaking create any additional axial load on the spine. The combination of the form of the vertebrae and the properties of the ligaments of the spine help to form the spine into a flexible beam like structure, resisting movement under rapid loading. Better active core stability makes the beam like structure of the spine more robust.

A final passive action is that of intra-abdominal pressure, which some authors consider to be a method of maintaining the natural arch of the spine, especially during lifting. The tension of the abdominal muscles has been suggested to support the natural curve of the lumbar spine and its relationship with the pelvis (Norris 2000).

3.2.10. The Active System – Thoracolumbar Fascia

The thoracolumbar fascia (TLF) is an important structure in spinal stabilisation, consisting of three layers of tissue which cover the muscles of the back (Norris 2000). The active system of the TLF has two mechanisms. One is its action on the posterior spinal ligaments to create the force closure of the vertebrae. Resistance to the force closure is created by the spinal processes, including those of the SIJ. The other action of the TLF is to constrain the belly of the erector spinae muscle to create the hydraulic amplifier effect. The combination of both of these actions is to create three beam-like structures which ascend the back of the body; two erector spinae muscle bulks either side of the vertebral column (see Figure 24 The Physiology of the TLF and Erector Spinae (Norris 2000, p.46)).

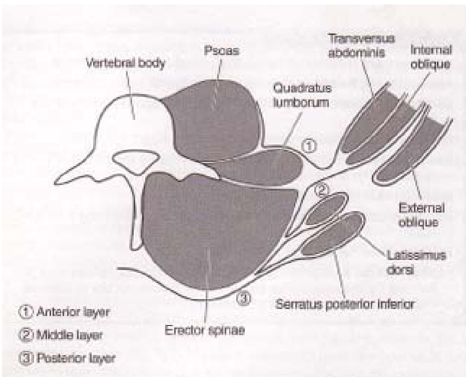


Figure 24 The Physiology of the TLF and Erector Spinae (Norris 2000, p.46)

3.2.11. The Active System – Muscles of the Trunk

The detailed anatomy of the trunk muscles is given in Appendix C, its key muscular structures include gross, superficial spinal extensors (mainly erector spinae) and gross superficial flexors (mainly rectus abdominis and external obliques) which control the extension and forward flexion of the spine when large movements are required. In addition there are muscles at the deep level to control fine movements of vertebrae within each segment. This reduces the movement of each vertebra against the next vertebra to create stability and an anchor against which the larger muscles can lever. This is the concept known as force closure.

The deep muscles include internal obliques, transversus abdominis (TVA) and multifidus. These muscles attach to the TLF, and together with some other large muscles (including latissimus dorsi and gluteus maximus) provide a pull on it to enable it to carry out its stabilizing functions.

The overriding importance of the deep muscles is in their function as core stabilizers. Stability enables a neutral spine position to be maintained, particularly the right amount of lumbar lordotic curve, so reducing the risk of wear and tear injury to the intervertebral discs at this level.

There is a further and final muscular activity that challenges the role of the core stabilizers. One of the hip flexors (psoas) originates at the lumbar spine and when contracted pulls it into hyperextension. The core stabilizers, especially multifidus, must provide a greater pull to prevent this and so maintain an appropriate lordotic curve.

Once there is appropriate stability of the lumbar curve, this provides a base for stability of the cervical and thoracic vertebrae.

3.2.12. A Practical Model of Core Stability for the Seating Designer

Core stability is built on the neutral alignment of a firmly keyed sacrum into the pelvis. A firm, aligned base provides the foundations for appropriately maintained primary (lordotic) and secondary (kyphotic) curves for the spine. Form and force closure provide this foundation for neutral spinal alignment, involving all four of these curves.

Maintaining the base, primary and secondary curves and active musculature of the trunk increases the potential safe working load under which the spine is able to operate without compromise to tissue structures.

The goal of rehabilitation is to enable the active back system to take more load. Norris (2000) suggests that back rehabilitation must balance improvement in elements of all three stabilizing systems; active, passive and neutral. I use this as my start point for creating active back support for the athlete with a reduced function in the active or passive elements of their trunk stability system.

Manufacturing core stability for the athlete with spinal cord injury therefore requires a range of stabilising and sympathetic supporting measures that safe guard alignment either directly or indirectly, both while the athlete is seated at rest and while dynamically active in their chosen activity.

3.3. Evaluation – Paddlesport Coaching and Evaluation Techniques for Seating and Posture

In this section I look at the trends in coaching, common coaching strategies in paddlesport and then identify techniques for the evaluation of posture. The aim here is to ensure that during the field testing and evaluation of any design the way in which the performer is being coached is understood, to identify the effects of the coaching process on the athlete's performance and therefore any feedback which may be gained and used in the design process. Additionally, this section helps further to clarify the language between the coach and the designer, providing a clearer feedback loop to drive the creative process.

3.3.1. Current Trends in Sports Coaching in the UK

The key trends in paddlesport coaching are concerned with longterm paddler development pathways. Work by the British Canoe Union (Tipper & Ward 2005) lays out a framework for the development of paddlesport athletes from the age of five to eighteen. The approach provides three focuses depending on the motivation of the athlete; foundation, recreation and performance, as shown in Figure 25. The approach also suggests physiological, skill and psychological or motivational focuses for each of the stages along an athlete's journey to their peak performance level; train to train, train to perform, train to excel.

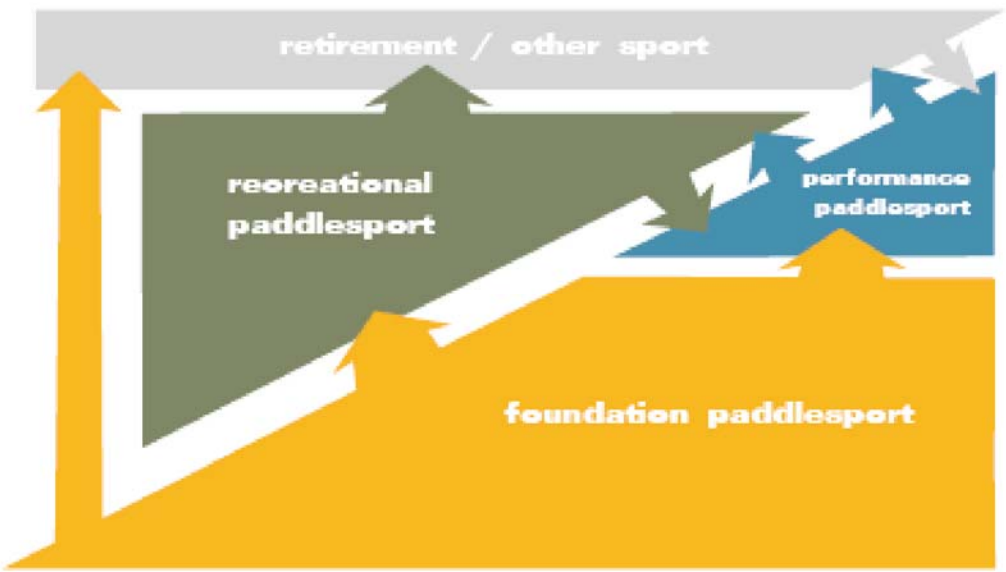


Figure 25 Levels of Participation (Tipper & Ward 2005, p.7)

Given that the focus of this research is for intermediate recreational athletes, the ideal outcome in terms of equipment design is a solution that meets the performance standard in the guidance that follows.

When discussing equipment Tipper and Ward (2005, p.12) state that equipment should be:

> *'Developed/ maintained to a level that supports injury free participation to the level required.'*

The training load for an intermediate level athlete is seven to fourteen specific training sessions per week (Tipper & Ward 2005). It is necessary for any equipment to be able to cope with this level of usage. Discussions with paddlesport manufacturers, including a telephone conversation in November 2003 with Pete Astles, Managing Director of Peak UK, reveal that modern equipment is designed to last for two seasons. It then follows that equipment must be fit for purpose for 800 sessions (10 sessions x 40 weeks x 2 years). If each session lasts two hours then the equipment is required to last for 1,600 hours or 200 days, with an eight hour day.

3.3.2. Current Coaching Strategies in Paddlesport

Taylor (2006) outlines a range of key coaching strategies for the paddlesport coach, suggesting that learners should be involved in their own goal setting. The strategies outlined are; The Inner Game, Coaching Principles and Concepts, Guided Discovery, Coaching Via Learner Self Appraisal, Collaborative Learning, Coaching Using Questioning, Shaping and Chaining, Whole Part Whole, Copy Me Method, Direct Instruction, Practice Methods. For the designer these methods provide a potential toolbox for understanding and developing the problem statement.

3.3.3. The Design of Seating and its Metrics

In this section I look at the design of seating and how it can be assessed. The aim here is to provide a better understanding of the way in which seating is analyzed, to drive the creative process. By definition, kayaking is a dynamic seated sport. This section provides an opportunity for parallels to be drawn from other areas of seating study to benefit the research.

Vergara et al (2006, p.938), when considering the usefulness of clinical assessments in ergonomic evaluations of seating, suggest:

> *'In short, clinical procedures provide no suitable references for ergonomic applications in the analysis of the sitting posture.'*

This is because the nature of ergonomics is that it is the study of dynamics, rather than static positioning. This backs up my previous findings, which show the importance of field based evaluation, in order to fully recreate all the variables involved in intermediate level paddlesport.

They also suggest that external markers cannot be used as a measure for an assessment to quantify lumbar flexion by non clinical staff. Although clinical staff could use these measures, the use of resources as outlined in Chapter 2 of my research, mean this is not viable. However, external markers can be used as a measure of lumbar movement. According to Vergara et al (2006, p.941):

> *'For the external location of the lumbar vertebrae by a non-expert person, two landmarks on the back have been shown to be the most easily identifiable ones: the most prominent spinous process at neck level (M1) and the upper point of the iliac crests (M2). […]In this regard, the external lumbar angle may be used to assess lumbar mobility, either for medical or ergonomic purposes, but always in*

comparison with different postures of the same person, i.e. it cannot be interpreted in an absolute manner, but it is useful for providing relative measurements.'

The need therefore is to identify assessment tools for use in the field without the need for detailed examination.

Maltais et al (1999, p.91) state that the aim of seating is to improve posture, distribution, alignment and comfort. They go on to suggest that the following geometric relationships between body segments and a range of mechanical properties can be used as a method for assessing the effectiveness of a seating system. I see this as a start point for the development of a field based assessment method, as shown in Table 17 Geometric Relationships between body segments in posture, Maltais et al (1999, p.91).

Table 17 Geometric Relationships between body segments in posture, Maltais et al (1999, p.91)

Relationship	**Definition**
Knee angles KAL:	Defined as the angle between two lines joining the left malleolus, left condyle of femur and left trochanter projected on the sagittal plane. KAR: Defined as the angle between two lines joining the right malleolus, right condyle of femur and right trochanter projected on the sagittal plane.
Thigh angles TAL:	Defined as the angle between the transverse plane and the line joining the left condyle of femur and the left trochanter. TAR: Defined as the angle between the transverse plane and the line joining the right condyle of femur and the right trochanter.
Hip angles	Defined as the angle between two lines joining the left condyle

Relationship	Definition
HAL:	of femur, left trochanter, and the left iliac crest projected on the sagittal plane. HAR: Defined as the angle between two lines joining the right condyle of femur, right trochanter, and the left iliac crest projected on the sagittal plane.
Pelvic tilt: PT1	Defined as the angle between the transverse plane and the best fit plane formed by the left and right ASIS and the left and right trochanters. PT2: Defined as the angle between the transverse plane and the best fit plane formed by the left and right ASIS and the left and right iliac crests.
Pelvic obliquity PO1:	Defined as the angle between the transverse plane and the line joining the left and right ASIS, projected on the frontal plane. PO2: Defined as the angle between the transverse plane and the line joining the left and right iliac crests, projected on the frontal plane.
Pelvic transverse rotation PTR1:	Defined as the angle between the frontal plane and the line joining the left and right ASIS, projected on the transverse plane. PTR2: Defined as the angle between the frontal and the line joining the left and right iliac crests, projected on the transverse plane.
Trunk lateral tilt TLT:	Defined as the angle between the sagittal plane and the best fit plane formed by the inferior and superior extremity of the sternum and C7.
Trunk transverse rotation TTR:	Defined as the angle between the frontal plane and the best fit plane (obtained by singular value decomposition) calculated from the eight points marked on the middle of each lateral side of the trunk.

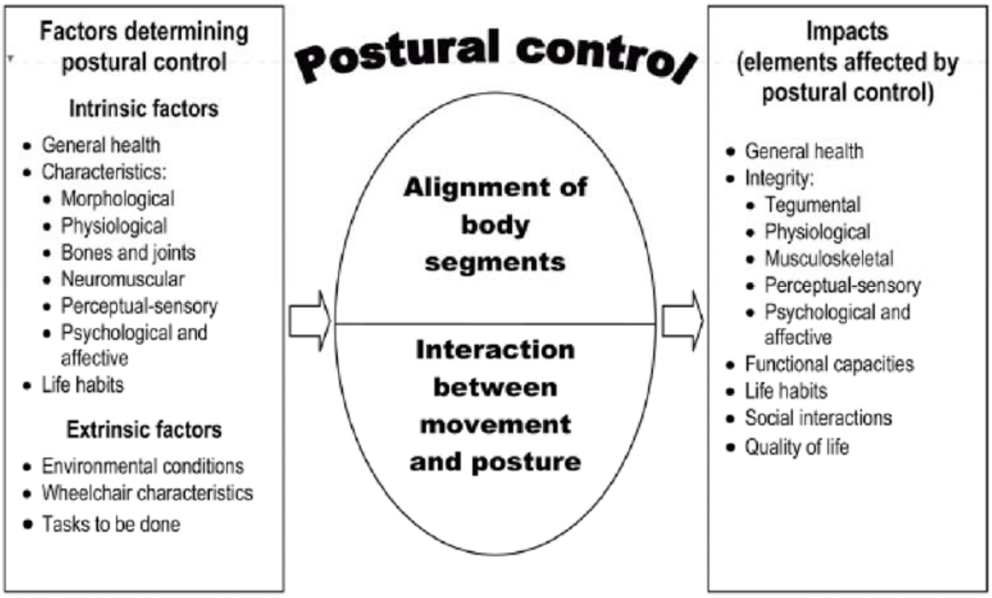


Figure 26 Postural control, determinants and impacts, from Gagnon et al (2005, p.952)

Postural control has been seen in context against a range of intrinsic and extrinsic factors, as shown in Figure 26 Postural control, determinants and impacts, from Gagnon et al (2005, p.952).

The framework shown in Figure 27 I suggest is a useful tool as it provides the base line for a standardised assessment of posture which is visual and able to be used in the field. It could be utilised to support understanding about the posture of the athlete for the individual, coach and designer simultaneously.

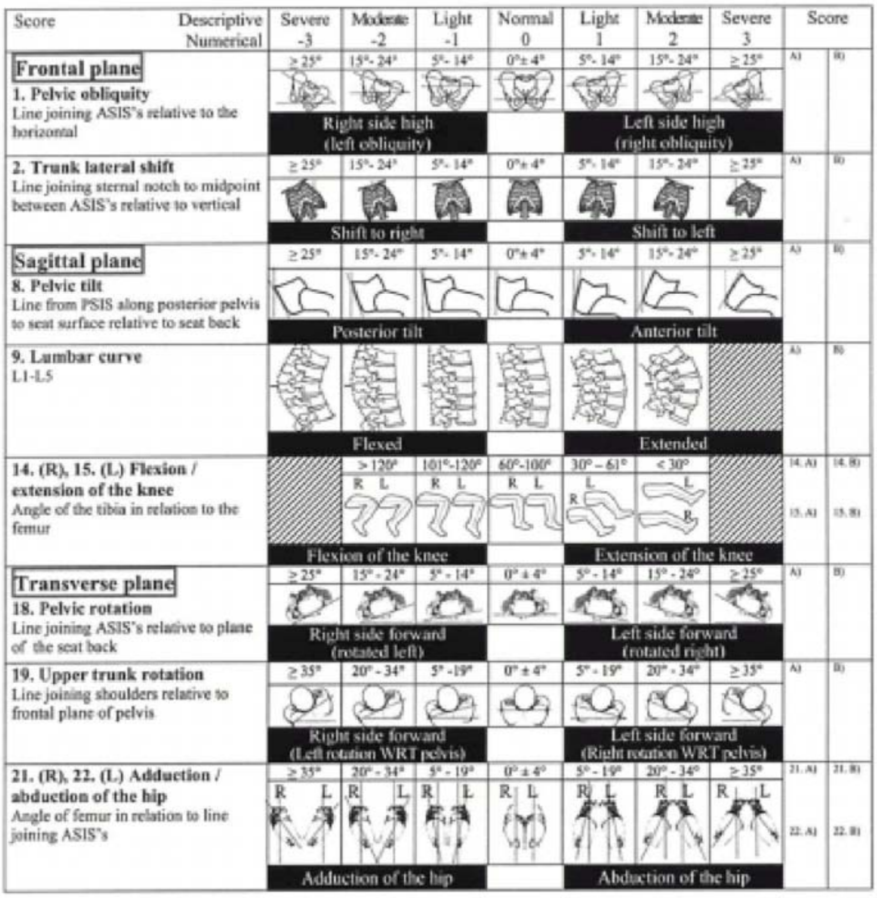


Figure 27 Seating evaluation schema scoring, from Gagnon et al (2005, p.956)

With regard to pressure distribution of the subject on a seating surface, Maltais et al (1999, p.93) suggest that the key parameters relate to placement of the ischial tuberosities:

> *'Mechanical parameters were defined to characterize the pressure distribution between the subject and the wheelchair cushion. Maximum pressures, mean pressures and pressure gradients were defined from pressure distribution measurements on the wheelchair's seat. Based on the assumption that it is possible to isolate two regions related to the ischial tuberosities, two sides were defined on the pressure mat system*

(left and right). The separation was delimited as the median line of sensors between the thighs.'

I see this as a start point for assessment, although I note that other prominences are also at risk. According to the National Institute for Health and Clinical Excellence (NICE 2007), common places for pressure sores are in areas where bones are close to the skin, such as the bottom, heal, elbow, ankle, shoulder, back and back of the ear.

It is clear that the care of tissue is a key function of a piece of the proposed equipment. Tissue viability is considered in further detail as part of a review of the materials and design of wheelchair cushions, in Section 3.4.3.

3.4. Equipment

This section reviews standard and adaptive equipment currently available, to form a start point for the creation of new solutions which are better able to fit the requirements of paddlesport athletes with SCI.

3.4.1. Outdoor Equipment Market

It is necessary to consider the outdoor equipment market from the perspective of the manufacturer in order to identify the production constraints for the design outcome of the research.

A review of the industry on behalf of the Outdoor Industries Association by Grundy (2006) reveals that while outdoor activities are very popular, with a steady growth of 2.5 to 3% across Europe and approximately 4% in the UK, most outdoor users in the UK do not expect to have to be a member of a club or other organisation in order to access the outdoors.

Further discussion with Grundy, in a telephone conversation on 15th December 2007 about the effect of market changes on manufacturing and manufacturers, suggests that the vast majority of manufacturing is offshore. This will remain the case, though over the next ten years, as the Chinese economy matures and consequent labour and space costs go up, the focus may broaden to include economies like India. Manufacturers have enjoyed reasonable margins for the past few years, but rising oil costs as well as Chinese costs are putting some pressure on that. For UK manufacturers' sourcing offshore, the sterling/dollar exchange rate has had a big positive effect.

Additional discussions with practicing designers (meeting with Adrian Moore, Managing Director of Aguille Alpine on 14th November 2006, telephone conversation with Tim Fish, Director of Tim Fish Designs, 29th October 2007) suggest that manufacturers are consolidating ranges to make it easier to cope with overseas production. The impact of this on low volume production is to limit the range of manufacturers available in the UK who work in appropriate fabrics or hold fabric stock. According to Moore, in the meeting of 14th November 2006, the lack of large quantities of materials held by UK manufacturers creates difficulty in keeping a particular item on the market.

It is clear that there is a tension here in terms of scale. The emerging niche market for outdoor sports equipment for disabled people needs to be met in a cost effective manner. Affordable products need to be maintained in a market sector that is sparse with fluctuating UK manufacturing resources.

It is necessary to create a viable manufacturing resource for the future. I suggest that this can be achieved by one or a mix of three options; by utilising the remaining infrastructure of the UK outdoor manufacturing industry, by setting up low scale batch production until such time as the market may mature sufficiently to support a larger manufacturing base, or by supporting self make options.

3.4.2. Mobility Equipment

One of the most common assistive devices used by people with mobility difficulties is a wheelchair. The following sections look at the design of the key elements of a wheelchair to provide a start point for the sea kayaking seating solution. I begin, in this section, by looking at the backrest and cushion design, these being the key interfaces with the body in a seated position. According to May et al (2004 p.1146):

> *'The selection of an appropriate wheelchair and seating system is an important decision during the rehabilitation of people with spinal cord injury (SCI) and requires consideration of the person's environment, posture, and mobility.'*

They go on to suggest that the seat cushion should provide postural support and comfort, and that the back support is crucial as any part of a seating intervention to restore pelvic position and improve trunk stability.

With regard to the way in which the performer or user interacts or controls any piece of assistive equipment, I take the stance offered by Cooper et al (2006, p.447):

> *'The mastery and functional use of assistive technology can be instrumental to self-esteem, activities of daily living, employment and community integration.'*

This supports the assertion that there is a link between the quality of seating equipment and opportunity for the user.

3.4.3. Standard Back Rest and Cushion Design for Daily Use

When considering the back rest of the wheelchair, it is clear that the back rest also has a dramatic effect on the functional ability of the user. According to Kersti et al (2004, p.73):

> *'The nature of the chair's seat and back can also affect dynamic function, such as wheelchair users' ability to propel themselves on varied surfaces, up and down inclines, and over obstacles such as kerbs. Changing the position of the rear wheels and, because of this, changing the weight distribution and seat angle of the wheelchair, significantly affected propulsion ergonomics concerning push frequency and stroke angle. Other aspects related to physical effort and estimated ergonomics on propulsion and seating changed, but not in a significantly uniform way.'*

May et al (2004) state that wheelchair system selection is based on clinical judgement and client preference, as well as client comfort and availability. In their comparison of a range of back rests on a small sample of study users with SCI, May et al (2004, p.1149) report that:

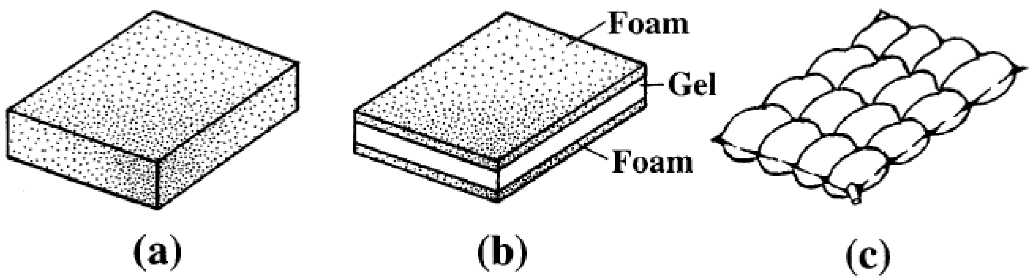
> *'The choice of back support may be influenced by two factors: the participant's satisfaction and the ability of the back support to facilitate functional performance. Most participants indicated preference for a back support that had facilitated functional performance for at least one of the tasks evaluated. Participants' comments also include reference to functional performance. It may be necessary to include both subjective and objective ratings for informed decision making.'*

This underwrites the need to work collaboratively with the performer to ensure that the design of any equipment intervention is based on both sound clinical reasoning and the informed choice of the participant. As noted by Kersti et al (2004, p.66):

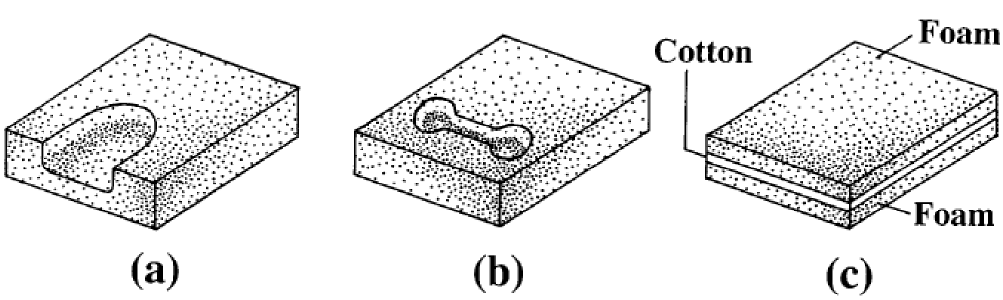
> *'Good seating ergonomics require the chair to be designed to suit the user and the task.'*

3.4.4. Seating Material Characteristics for Tissue Viability

In this section I look at the materials used commonly in the production of wheelchair cushions. The aim is to provide a vocabulary for design exploration and innovation.



Ready made cushions;
(a) Polyurethane flat foam, (b) silicone gel flotation, (C) air-filled pad



Custom made cushions;
(a) cut out type 1, (b) cut out type 2, (c) combined type

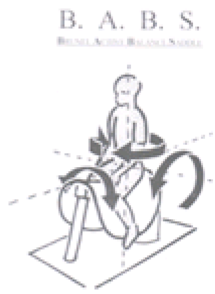
Figure 28 Designs and materials commonly used in wheelchair cushioning, from Sumiya et al (1997, p.592)

Sumiya et al's (1997, p.592) review of wheelchair cushion use in Japan, see Figure 28, reveals the following primary criteria for cushion performance and selection; shearing force, humidity, temperature, and sitting stability. Secondary characteristics were; variable weight, cost, and durability. Their study suggests that cushions fall into two main categories; ready made and custom made.

Whilst I recognize that there are a large number of seating solutions available for wheelchair users, I consider this to be a map of the key materials in use.

3.4.5. Equipment Solutions for the Disabled Seated Performer

In this section I look at ways in which seating solutions have been provided in the past or look for parallels in other areas of seating and performance. Examples of adaptive seating and performance include; the Brunel Active Balance Saddle (BABs), seated skiing both on snow and on water, wheelchair racing, wheelchair basketball, wheelchair rugby, wheelchair throwing chair, as shown in Figure 29.

Brunel Active Balance Saddle	http://www.brunel.ac.uk/about/acad/health/healthstaff/healthstaff/michailidou/cp
	

Provides no back support pelvis and legs aligned around saddle shape to mimic a riding position for therapeutic use.	
Seated snow skiing	Spokes 'n Motion (2007a)
PRASCHBERGER Monoski	
FREEDOM FACTORY Revolution Pro Comp	
FREEDOM FACTORY Mogul Master SP	
TESSIER Monoski	
TESSIER VFC Monoski	
Upright seated position. Bucket seat with support provided by variable angle back support, lumbar padding, pelvis and thigh constrained by moulded structure (Carbon Fibre), knee and leg alignment maintained by foot rest or foot bucket. Active elements include suspension unit between ski and seat and abdominal band.	

Seated water skiing	Spokes ‘n Motion (2007b)
BMF Beginner Sit-Ski	
The BMF Fat Boy is designed with a flat speed bottom and wakeboard style edge for a maximum speed.	
The BMF Hybrid is designed with a tunnel bottom and wakeboard style edge.	
The BMF Jump 96 ski is a very exciting ski.	
Upright seated position. Rigid frames which constrain the hips and pelvis, in a slung fabric bucket seat. Knees constrained by padded frame and feet constrained by foot strap.	
Wheelchair Racing	http://secure.srginc.biz/search_list.php?brand=sa&strID=79#source=google
Invacare Top End Eliminator OSR Kneeling	

<table>
<tr><td>Invacare Top End Eliminator OSR Standard</td><td></td></tr>
<tr><td colspan="2">Upright seated, semi kneeling position with legs folded under the base. Slung or rigid base with hips and pelvis constrained by side plates and rigid back rest. Sitting angle used to create a bucket position.</td></tr>
<tr><td>Wheelchair Basketball</td><td>Melrose Wheelchair (2007)</td></tr>
<tr><td>Melrose
Orion</td><td></td></tr>
<tr><td colspan="2">Similar to a standard day use chair with geometry biased to balance manoeuvrability in open space and stability. Seat camber bucket and wheel camber adjusted to suit the individual.</td></tr>
<tr><td>Wheelchair rugby</td><td>Melrose Wheelchair (2006)</td></tr>
<tr><td>Defender</td><td></td></tr>
<tr><td colspan="2">Similar to a standard day use chair with geometry biased to balance maneuverability in open space and stability. Seat camber bucket and wheel camber adjusted to suit the individual. Frame has also been strengthened to cope with impact from other chairs during the game.</td></tr>
</table>

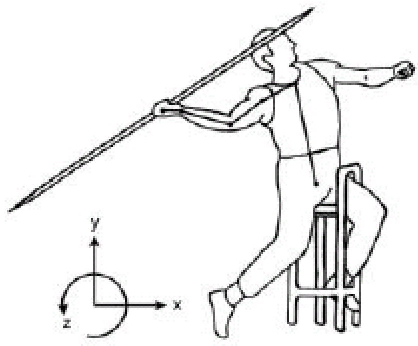
<table>
<tr><td>Wheelchair throwing</td><td>(Chow et al 2003, p.45)</td></tr>
<tr><td></td><td>
</td></tr>
<tr><td colspan="2">Perching stool that prescribes the performance position of the athlete to reduce the effect of the lower body in the throwing action by providing a contact point for the buttock and upper thigh during the throwing motion (Chow et al 2003, p.37-38)</td></tr>
</table>

Figure 29 Seating Solutions for Wheelchair Sports

Figure 29 shows that the range of sports equipment used by seated athletes is passive and does not provide any active element, with the one noticeable example being the ski chair. As seen previously, the use of the torso in kayaking is vital. Kinematics studies of the Javelin Chair, such as that by Chow et al (2003, p.45) suggest that the torso plays a vital factor even in seated sports performance for disabled athletes:

> *'The ability of the torso to support effective arm and leg actions (the so-called core stability) is essential to performance and injury prevention in many sports. To provide a stable base for shoulder and arm motions, wheelchair javelin athletes should strive to maximize their functional potential in trunk movements. In addition, they should explore a chair design that allows a sitting position and technique for optimal control of trunk movements. Instead of leaning backward at the instant of release,*

athletes need to experiment different techniques so that they can have a more erected posture at the release of javelin. Within their functional capability, athletes in the lower classes are encouraged to improve their wrist flexion actions during the delivery.'

Additionally the role of the trunk in wheelchair racing has been recognised by Chow et al (2003, p.45) as follows:

'To the best of the authors' knowledge, there are no biomechanical studies specifically addressing the role of the trunk in hand rim wheelchair propulsion.'

Vanlandewijck et al (2001, p.347) state:

'Nevertheless, trunk motion might be one of the most important force-generating mechanisms during fatigue, or high resistance wheeling, such as accelerating from standstill, sprinting or uphill driving. Furthermore, trunk motion will directly affect rolling resistance and air drag. In wheelchair sports classification procedures, trunk range of motion has been determined as one of the key parameters in identifying the functional potential of wheelchair sportsmen.'

This further strengthens the argument for using core stability as a framework for understanding posture for both disabled and non disabled performers.

3.4.6. Sea Kayak Seating and Cockpit Designs

The cockpit of a kayak is the name given to the area in which the kayaker sits. The design of the cockpit has a direct effect on the safety of a kayaker in the case of a capsize or entrapment. Ferrero (1998, p.105) states:

'When the very first plastic boats came on the market, the materials used in the manufacture of a spraydeck were not very 'stretchy'. As a result cockpits were made as small as possible to minimize the chances of a wave collapsing the spray deck. Boats made in ordinary fibre glass tended to break up if they were badly broaching giving the paddler a chance to fight his way out. With plastic and diolen /carbon fibre combinations this no longer happens; therefore cockpits must be designed in such a way as to make it possible to exit the boat even if the deck is collapsing. This is achieved by making a 'keyhole' shape. When the paddlers knees are splayed out they grip the thigh braces and when the knees are brought together, they are no longer held in.'

3.4.7. Types of Boat and Sea Kayak

Sea Kayaker Magazine (2004) suggests two sets of metrics for the evaluation of the performance properties of a sea kayak; measurements and hydrostatics. Measurements are; length overall, beam, volume, cockpit size, cockpit height, height of the seat, weight. Sea Kayaker Magazine (2004, p.1) defines hydrostatics as:

'The hydrostatics describe the relationship of the kayak to the water it sits in. As the load in a kayak varies by its weight and distribution, so does a kayak's hydrostatics.'

Waterline length, waterline beam, draft, prismatic coefficient, wetted surface, centre of buoyancy, block co-efficient, effective waterline length and pounds to immerse one inch, are the characteristics used to predict the speed and stability of a given craft. Prediction is often inaccurate due to the nature of the moving performance environment. Sea Kayaker Magazine (2004) presents three practical performance measures; speed vs resistance, primary, and secondary stability. Primary stability is defined as how stable the kayak feels when it is at rest, secondary stability is defined as the force with which the kayak resists seeing the kayak on the edge. It is noted that it is possible to design a kayak that is able to make a smooth transition between primary and secondary stability so as not to catch the performer out. With regard to practical field testing the following is noted by Sea Kayaker Magazine (2004, p.3) when considering comfort and perceived performance:

> *'The subtle adjustments to balance they made while sitting in the kayak made it possible to have the subjective feeling of a functional degree of stability.'*

This suggests that given the nature of the performance environment, the user and the boat, a high degree of observation and questioning will be required to be able to unravel the performance and success of each piece of equipment from other factors.

3.4.8. Cockpit Fittings

Mackereth (2002) suggests that control comes from contact with the boat. He goes on to suggest a range of ideal characteristics for the main internal features of kayaks. These are summarized in Table 18.

Table 18 Summary of Cockpit Fittings, based on Mackereth (2002, p.30)

Component	**Function / Description**
Fittings	Hold you in when you want to be held in but not impede you when you want to get out. This is essential. Not be so padded that they isolate you from the feel of the canoe, or prevent you from transmitting your energy into

Component	Function / Description
	performance. Make you comfortable so that you can concentrate for as long as you might have to sit in the boat.
Seats	Seats should combine grip with support. Kayaks use mostly bucket seats with adjustable back rests.
Thigh Grips	These are essential for white water competition and recreation kayaks and are increasingly found on sea kayaks. They should be adjustable in length and have enough hook to grip your thighs (wherever on your thighs you find it most comfortable), but not so hooked that you can not flatten your legs to bail out quickly if necessary.
Foot Rest	These are simple low cost units which are usually easily adjustable pedal foot rests on a runner on which you place your foot. A better foot rest is found in racing kayaks which is a broad plate foot rest that extends across the full width of the kayak. This enables you to place your foot in the most comfortable place. They are not easily adjusted. For use in advanced white water the foot rest must be shock absorbing. A full plate foot rest should be able to stop the paddler going over or under (if trimmed properly) in even the most aggressive impact situations. Trimmed properly, they could prevent broken ankles or legs, and in the worst case scenario save lives.

3.5. Water Safety – Accidents, Behaviours, Attitudes and Rescues

In this section I consider some of the key issues to do with water safety within paddlesport. The aim here is to understand the key safety issues for seating design with regard to seating systems used on water. There are many definitions surrounding safety, but the following definition from Labbett (2006, p.1) became common parlance during the Canada Alaska Expedition which is presented later in this research:

'A rare, random, multifactor event in which one or more road users have failed to cope with their environment.'

It is from the perspective of the need for shared responsibility and skilful performance that I see safety. Laird (2005) discusses the cost of accidents, suggesting that willingness to pay for the consequences of an accident varies depending on the perceived consequences, the perceived control of the user and how voluntary or involuntary their actions are. This suggests that any given design solution will be perceived in a range of ways depending upon individual attitudes to risk and the perceived benefit of any increase in access to paddlesport.

In terms of design, this section provides a framework for contextualizing the behaviours of the performer in terms of managing risk, making it possible to frame observation and analysis. Ferrero (1998, p.9) when talking about white water safety suggests:

'Safety is the art of staying out of trouble.'

Ferrero (1998, p.10) goes on to state five key principles of white water safety:

'Principle of; 1) mutual support, 2) line of sight, 3) calculated risk, 4) clear communication, 5) prevention.'

The relationship between the skill of the performer, the equipment and the risk are also identified as a key principle of safety. This is an important factor for the sports equipment designer, as it demands that objects are created that provide access to a sport and also cater for the performer as they develop their competence. Equipment must facilitate all levels of performance in a fail safe manner. According to Ferrero (1998, p.40):

> *'The best way to become a safer paddler is to become a better paddler! When combined with the ability to read water, skill is a far better guarantor of safety than a face helmet and body armour.'*

Lull (2001, p.47) suggests that most successful rescues are 'simple and efficient' and suggests the following issues concerning equipment:

> *'You can count only on gear that you know how to use and have tested in a variety of circumstances. […] Your kayak is your life line. Actually this is true for any boat out in open water; if you lose the boat you could lose your life.'*

Lull (2001, p.31) also suggests that choice of boat for a given set of conditions is a further factor in safety:

> *'Using the best sea kayak for your purpose and the conditions increases your margin of safety.'*

From reviewing the literature and the practice-based material in this area I get a sense of the absolutism of the performer. As a designer I sense that there is little room for error and that an object will either just work or not.

3.5.1. Capsizing and Rescue Techniques

Inverting the kayaking and exiting in deep water can be hazardous. In deep water it is not always possible to get to shore, as when sea kayaking, especially at an intermediate level. This section considers the key principles of sea kayak rescue, to find a start point for the specific sea kayak safety issues which concern paddlers with SCI. According to Lull (2001, p.47):

'Capsizing is part of kayaking, especially during the early stages. […] If you capsize and can't perform an Eskimo roll or fail to execute your roll, your only recourse, short of a bow rescue, is to exit the kayak and then re-enter. Because a partly swamped kayak is unstable, simply climbing back in without assistance is difficult especially in rough water.'

Lull recommends a Scoop Rescue for the recovery of an unconscious or injured swimmer, as shown in Figure 30 Scoop Rescue – Incapacitated Swimmer, from Lull (2001, p.65).

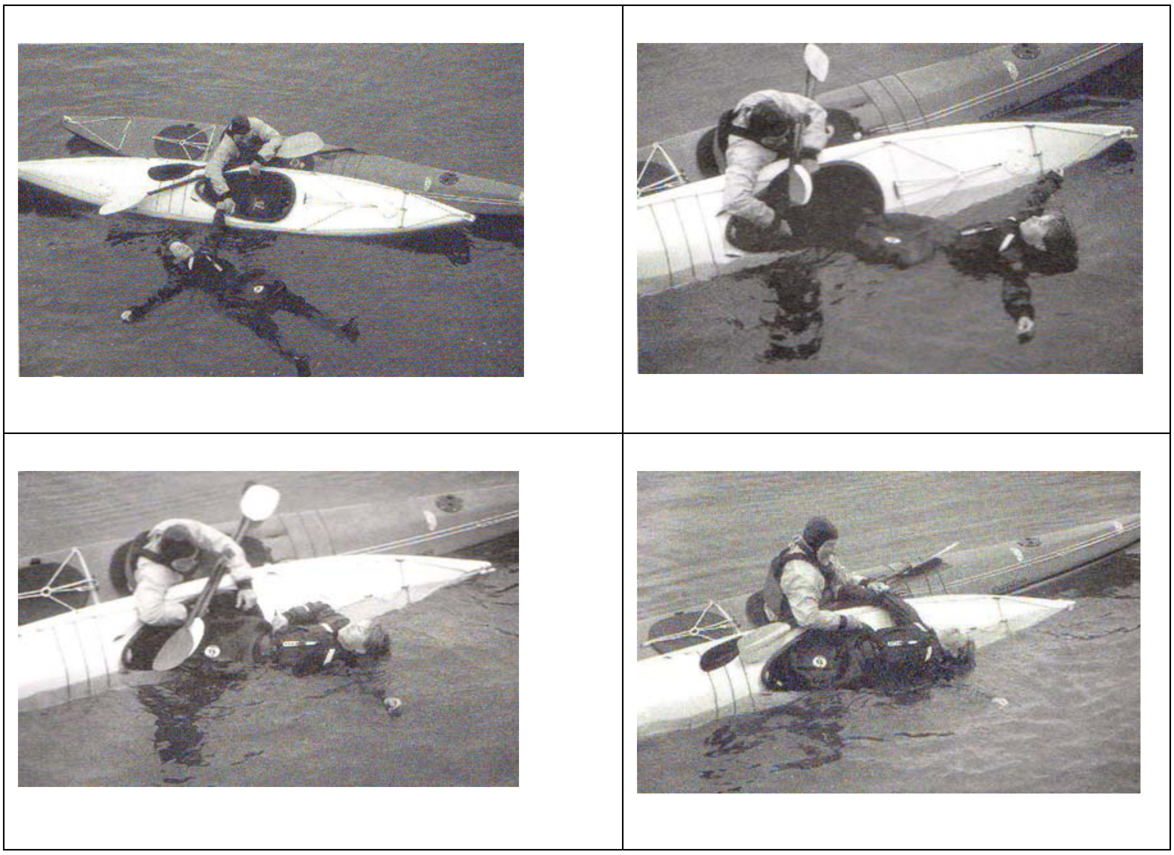


Figure 30 Scoop Rescue – Incapacitated Swimmer, from Lull (2001, p.65)

Finally, Lull (2001) suggests that the sea kayaker has four levels of defense or backups to ensure their safe participation, as listed in Table 19 Levels of Backup, from Lull (2001, p.65).

In design terms it is levels 1-3 shown in Table 19 that are of most interest, as creating a solution that facilitates independence is of paramount importance.

Table 19 Levels of Backup, from Lull (2001, p.65)

Level 1	Judgement and primary skills Knowledge and experience Boat control (propulsion, maneuvering and strokes) Seamanship Balance and edge control (boat lean)
Level 2	Recovery skills Basic strokes (capsize prevention) Eskimo roll (boat lean)
Level 3	Rescues Assisted rescues Self rescues
Level 4	Outside assistance Flares Radio Other signalling devices

3.5.2. Safety and Equipment Design for Paddlesport – Clean Line and Entrapment

This section can be seen against the backdrop of personal protective equipment (PPE). The Health and Safety Executive (HMSO 2005, p.1) state:

'The main requirement of the PPE at Work Regulations 1992 is that personal protective equipment is to be supplied and used at work wherever there are risks to health and safety that cannot be adequately controlled in other ways.'

The Regulations also require that PPE; 1) is properly assessed before use to ensure it is suitable; 2) is maintained and stored properly; 3) is provided with instructions on how to use it safely; 4) is used correctly by employees.

Both the athlete and the coach clearly share the responsibility for the safe use of equipment with the designer, especially in a dynamic outdoor environment where the conditions can place a wider range of demands on equipment and athlete within one single experience.

When reviewing the key issues concerning safe design of paddlesport equipment from the perspective of a performer, two key issues are presented by current expert practitioners; clean line and entrapment. With regard to clean line, Ferrero (1998, p.123) states:

'If your brand of throw-line comes complete with a knot or handle at the thrower's end then cut it off.'

The principle of clean-line is now common across all paddlesport disciplines. The principle suggests that it is inappropriate to use anything which creates an entrapment for a person, or increases the likelihood of a trailing strap catching around a rock, in a crack or around a branch while in the water, as it could submarine the swimmer.

When considering the entrapment of a victim in water, Ferrero (1998, p.175) suggests the following remedies:

'Pulling the victim in the right direction, freeing the boat and in the process freeing the victim, cutting any webbing of line that is holding the victim, removing the obstacle that is causing the problem.'

Ferrero's (1998) assertion suggests that the designer needs to consider the direction of movement between the kayaker and any piece of equipment during an emergency situation. Additionally, the need to be able to cut any material is key to the potential extraction of the kayaker from any piece of equipment. It also suggests that the choice of materials and the layout of any webbing or joining that may snag also needs to be taken into account.

These principles affect the choice and configuration of materials. I therefore consider them as key design principles.

3.5.3. Water Safety for Disabled Paddlers

A literature review reveals little concerning water safety for disabled kayakers. The National Water Safety Forum (CCPR 2006, p.3) suggests the following when considering disabled people becoming watersports instructors, responsible for the safety of others on the water:

'[…] that each National Governing Body (NGB) needs to look at individual circumstances and conduct relevant individual risk assessments. If specific measures can be put in place then the individual should be allowed to instruct.'

With regard to adaptive equipment, Smedley (1995, p.87) identifies the conflict between performance gain and safety, given the potential consequences of a capsize, as follows:

'Some people with lower body impairments have been able to stay in their kayaks when executing maneuvers that would otherwise cause them to fall out, by strapping themselves in.'

Smedley (1995) also suggests that any strapping system should have the following characteristics; 1) the person is able to release the system should they need to exit the boat, 2) the height of the strapping must work in relation to the function, i.e. supporting the chest or holding the pelvis when upside down.

I see this as a key issue for any design solution. The conflict between different attitudes towards risk are a key issue for the planning of any field work, especially given the prospect of any potential gain for a participant hoping to move up the performance ladder.

3.6. Adaptive Adventure and Paddlesport Equipment

3.6.1. Activists in Inclusive Outdoor Design Producing Tools for the Development of Equipment

In this section I seek to identify other design solutions for inclusive adventure design. A web search and literature review reveal few organisations dedicated to developing inclusive outdoor adventure equipment. A web search reveals the following key players, as shown in Table 20.

A review of the methods of this small community reveals that there are few codified tools for development of equipment, suggesting that any structured design research should not only produce an appropriate artifact, but also contribute to the creation of formal methods and development tools that can be used to best effect.

Table 20 Designers of Adaptive Outdoor Equipment

Organisation	Mission or Stated Aim
Beneficial Designs (USA)	Beneficial Designs (2006) works towards universal access through research, design, and education. We believe all individuals should have access to the physical, intellectual, and spiritual aspects of life. We seek to enhance the quality of life for people of all abilities, and work to achieve this aim by developing and marketing technology for daily living, vocational, and leisure activities.
BlueSky Designs (USA)	BlueSky Designs (2006) applies ergonomics and universal design to develop products that address the needs of people with and without disabilities - at work, at play, and at home. The resulting products make activities easier for and more accessible to everyone.
Equal Adventure (UK)	Equal Adventure (2007) is a not-for-profit social enterprise based in the Scottish Highlands. We develop resources that support and inspire inclusive adventure and active lifestyles.

3.6.2. Current Solutions Adaptive Paddlesport Seating Solutions

This section identifies and evaluates current solutions for postural supports for kayaking for people with limited sitting balance. It seeks to ensure that any further design research is able to build on past work in this area. Work undertaken by the author in this area is evaluated separately in a more formal manner to help maintain the legitimacy of the data under consideration.

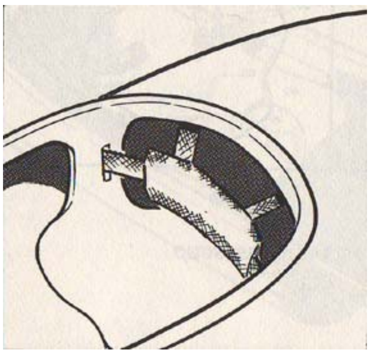
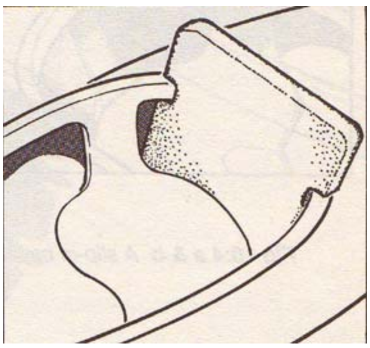
By reviewing the current seating solutions on the market in kayaking against the needs of the performer with SCI, it is possible to ensure that a solution is developed which meets both the needs of the user and the performance environment. This section also provides a review of the types of craft in which the equipment design may be used.

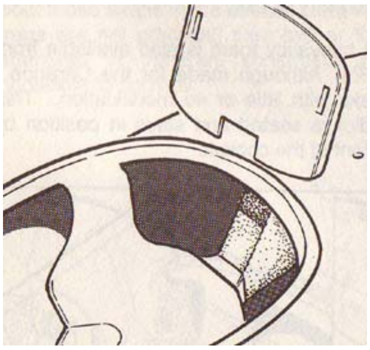
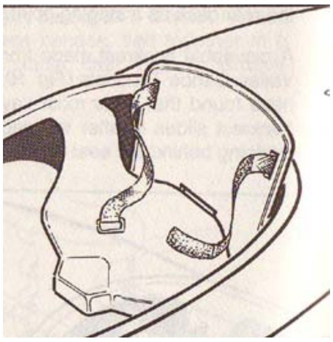
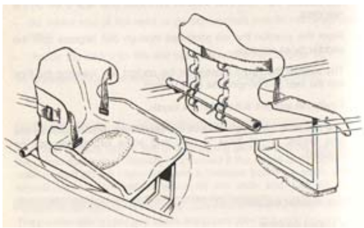
Smedley (1995, p.81-97) suggests a number of solutions for adaptive paddlesport when considering balance:

> *'The person may need support to the back, or the side or both. Not being secure in the seat makes paddling difficult and the feeling of insecurity may add to anxiety levels. […]*
>
> *The aim is to make the person secure and stable without compromising their ability to exit the craft in an emergency.'*

Table 21 summarises the adaptive kayak seating options currently recommended in national governing body publications.

Table 21 Adaptive Kayak Seating Designs

Reference	**Image**	**Description**
Kayak Strap, Smedley (1995, p.83)		Standard Kayak back rest.
Modified swimming float backrest, Smedley (1995, p.83)		Closed cell foam pad with recesses to fit the rim of a cockpit. Leans against the back rim of the cockpit and against the back of the seat. No adaptation required.

Reference	Image	Description
Slip in back rest with or without chest strap, Smedley (1995, p.83)		Tailored closed cell foam to accommodate the central buoyancy at the rear of the kayak.
		Tailored closed cell foam to accommodate the central buoyancy at the rear of the kayak, with lap strap.
Glass fiber brace, Disney (2001)		Glass fiber brace that fixes the users pelvis, the key shape wedge fits into a slot at the back of the seat (this is pre-moulded).
Derwin's Backrest, cited in Smedley (1995, p.82)		Glass fiber molded with seat base padding for use in open canoe.

Reference	**Image**	**Description**
Theobald's Backrest, from Topkayaker.net		Tube construction with fabric and closed cell foam slung seat.
Equal Adventure Postural Support (EAD 2007)		Modular construction consisting of; stiffeners, padding, main body. The support provides a range of support levels by providing two options of height of external support to facilitate kayaking, canoeing, sailing, fixed seat rowing and rafting.

Whilst all of the solutions mentioned by Smedley (1995) are practicable and low cost, they are all passive and static and do not allow for the progression of the paddler from beginner to intermediate and then onto advanced level participation. The remainder of the examples are produced as one-offs, apart from the Aquabac.

3.6.3. The AQUABAC –Case Study

A web and literature review reveals only two studies on any of the above examples. Key points from each study have been included below for two reasons; 1) to suggest a start point for any assessment criteria, 2) to highlight any strengths or weaknesses of this design.

Bruce (1999, p.40) in a biomechanical study of the Aquabac when used in kayaking suggests the following:

> *'In biomechanical terms the support does facilitate good technique for the subjects analysed as well as providing increased comfort also. […..] The subject will achieve better results in terms of the stroke when using the postural support compared to when the postural support is not being used. In general it can be established that when using the postural support the subject's stroke was better, in that it was more efficient, had a longer stroke and was faster.'*

Hill (2000, p.6), in a further study of the Aquabac in fixed seat rowing suggests that:

> *'It has been shown that by virtue of the increased ROM (range of motion) the Aquabac does provide sufficient support, without adverse restriction, allowing fixed seat rowing for people with SCI.'*

From this we see that the Aquabac is successful in fixed seat rowing and kayaking. Additionally, range of motion, stroke efficiency and comfort have been identified as key success criteria for the Aquabac. I see these results as a starting point for both design and assessment criteria.

3.7. Conclusion – Hypothesis and Design Criteria

I have reviewed the nature of performance, the performer, seating and water safety. In conclusion I believe that this chapter suggests the need for a pragmatic user-centred design process which generates data from field experience with disabled lead user athletes. A full review of this chapter is given in Chapter four - Synthesis.

4.

Chapter 4

Synthesis

4.0. Chapter Introduction

The aim of this chapter is to provide a summary of the key themes of the literature review; it provides a fulcrum to the thesis, linking the literature to the beginning of the field research phase.

The first key theme summarised is personal perspectives – expanding skills (4.1). This is followed by presentation of disability (4.2) and method (4.3). Resource and development outcomes are summarised next (4.4), followed by participation and inclusion (4.5). Next is design process, (4.6), disability access and safety agenda (4.7), design, design process and social change (4.8), the design and sports equipment design methods (4.9), design process, outdoor activities, sport coaching and design (4.10), sport and adaptive sport (4.11), functional requirements (4.12), risk and adventure (4.13), performance of the athlete (4.14), equipment performance criteria (4.15). The chapter concludes with the hypothesis for the research (4.16), the research aim (4.17) and the seven research objectives (4.18) that have resulted from this literature review.

4.1. Personal perspectives – expanding skills

From a personal perspective (Section 2.2.3), I have recognised my need to expand my skills as a researcher, in order to ensure that I can engage with all the many different areas that influence the nexus between design, disability, sport and outdoor education. Without these skills, there would be no foundation of knowledge upon which to build for future research beyond this PhD study.

It is necessary to look beyond this study to ensure that there is a real and tangible benefit to the audience for the research: the disabled, outdoor and sporting communities (Section III). The investigator must be able and willing to engage with these communities if research is to progress into action. Successful engagement requires flexible working and the ability to work as a team player (Section III).

In order to maintain the validity of the methodology for this research and future research in this area, it is necessary to deepen my understanding of the user-centred inclusive design process.

4.2. Presentation of Disability

For the material within my research to have educational value to others while being understood by those who do not currently engage with disabled people, I will have to carefully consider my phrasing and use of language (Section 1.2). A respect for disabled people must be maintained throughout. Additionally I suggest that the presentation, or lack of presentation, of this research in the media needs to be considered further. I recognise that without engagement with mass media in some form, it is impossible to ensure that the communities for whom this research is undertaken will truly benefit.

Appropriate presentation of disabled people, both written and verbal, in the research process is another aspect that I must respect.

4.3. Method

For this study to be acknowledged by the disabled community, it is important to work from a positive, humanist stance (Sections 1.9.2 and 2.2.4), following the functional approach offered within the ICF (Sections 1.2 and 1.3.3).

It will be necessary to engage with personnel from a range of backgrounds including professionals from the realms of sport and rehabilitation (Section 1.4.3). For successful multi-disciplinary research to take place it will be necessary to create a positive learning environment (Section 1.9.4). This will ensure that all participants are able to communicate, and share a joint understanding of the problem statement and development process (Section 1.2.1).

It is clear that there is a need to explore the application of research and sports equipment design processes as part of an educational or coaching process (Section 3.3.2). Positive outcomes for all must be at the forefront in order to maintain multi-disciplinary stakeholder involvement (Sections 0 and 1.4.1).

It will be important to use a range of coaching strategies in the fieldwork setting to gather data from the athlete concerning their equipment requirements (Section 0).

The sparse availability of resources must be considered in the research and responsibility for the application of the research outcomes also needs to be considered, to ensure that the research project is holistic (Section 1.5).

The principle investigator must be aware of their responsibility for moral choices and ethical considerations within the methodology (Section 2.1). It will be important to balance environmental ethics through the use of sustainable technology and resources, to reduce the impact of physical outputs of the research (Sections 2.2.2 and 2.8).

The research must encompass the evaluation of current adaptive seating designs (section 3.6.2).

4.4. Resource and Development Outcomes

The method and outcomes need to be acceptable to the key stakeholders: athletes, coaches and sporting experts (Section 1.4.3). There needs to be new knowledge (Section 2.2.5) which is acceptable to all the stakeholders (Section 1.3.4), which support both amateur and professional athletes, or sport (Section 1.4.3).

It is necessary to create tools to unify and support developers of adaptive adventure sports equipment (Section 3.6.1). Currently there are few formal tools for the inclusive outdoor sports equipment designer.

4.5. Participation and Inclusion

Philosophical approaches to inclusive participation need to be explored (Sections 1.2.1 and 1.4.3) in order to ensure that the greatest benefit is gained from investment.

It is helpful to consider how the equipment development process can be used as an opportunity to develop the skill of the user or athlete (Section 1.5.1), supporting participation at a range of levels across the sports development continuum (Section 1.4.2), especially those who participate at the recreational to intermediate level (section 1.5.2).

Inclusive participation requires integration between people with different impairments, as well as between disabled and non-disabled people (Section 1.5.3). This study should explore ways of promoting all levels of inclusion. It should also assist the development of fair competition amongst disabled athletes

(Section 1.7) and support the development of inclusive performance pathways in outdoor activity (Section 2.4.5).

4.6. Design Process

The studies must explore a user-centred design process which incorporates both positive and negative approaches for the designer (Section 1.11.2), yet encompasses a learning environment built on success rather than failure for the athlete (Section 0). The research outcome should then be both practical and positive (Section 2.7.1), facilitating a more harmonious relationship between designer, coach and athlete.

4.7. Disability Access and Safety Agenda

The research should help society to support human rights (Section 2.2.1) and meet DDA (1995) legislation, supporting access to goods, services and facilities (Section 1.3.5). Further than this it should seek to increase participation in sport (Section 1.3.4), by reassessing the trans-theoretical model of behaviour change (Section 2.8.1) and evolving a new model relating to the outdoors (Section 2.9). These models may be utilised to help develop new ways of promoting interest, participation and performance in sport (Section 1.4.2). New fitness resources, including those which form dynamic images of disabled people participating will be required to encourage participation (Sections 2.3 and 2.8.2). In this way, the research may further empower disabled people, increasing the ability to work independently and take on leadership roles (Section 1.3.4). For the success of this increased interest in participation there should also be improved access to mainstream sports equipment (Section 1.4.2).

To inspire a behavioural change in the disabled community and associated cultural change in society, research must create an inspirational design case study (Section 2.8).

4.8. Design, Design Process and Social Change

The research must respond to socio-political design forces by taking a socially responsible approach that works within society's rules, yet also takes a radical approach to design in order to create new opportunities (Section 1.8.4). This provides the opportunity to create the most from the least (Section 2.2.2) and explores the way in which design can be used as a mechanism for social change in sport and society. It also ensures that the outcome of the research has an impact on individuals, groups and communities, as described in the spectrum of newness, so improving the chance of acceptance of any design outcome or innovation in opportunity (Sections 1.9.4 and 2.8).

The research should help change the view of disabled people in society and challenging the cycle of oppression (Section 2.8.2) and stereotypes of disability (Section 1.3.3), and promoting the designer's understanding of disability. By exploring the application of the ICF to sports equipment design (Sections 1.10.2 and 1.9.5) the designer will be able to promote function over body image and contribute to the reduction of social distance between disabled and non-disabled people (Section 1.3.1).

An evaluation of the IFI model should be undertaken to create a framework for development of opportunities in the outdoors for disabled people (Section 1.8.2).

4.9. The Design and Sports Equipment Design Methods

The research should explore and develop methods for placing the performer in the design-knowledge loop (Sections 1.9.3 and 0), including the knowledge management cycle, the design cube and the 7 level design process for sports equipment design (Section 1.9.5). This will help to ensure that current inclusive design tools and processes can be applied to sport in order to create resources for the next generation, by removing barriers to sport and health.

The development of a method for finding the real problem against the chosen method of participation (regular sport versus adapted sport) needs to be considered in the research (Section 1.10.2). A motivating activity, controlled by a coaching process, should be utilised in fieldwork to enable testing in an environment which has a constant level of meaning for the individual athlete (Section 0).

By creating methods for defining the inclusive sports engineering problem, the next generation of designers will be better equipped to create more sustainable and cost effective outcomes (Sections 0 and 2.7.1).

4.10. Design Process, Outdoor Activities, Sport Coaching and Design

The research must map the interaction between sport and design (Section 1.10), including addressing the relationship between equipment, coaching and performance (Sections 1.10.2, 2.5 and 2.7) to the benefit of those involved in this relationship: the designer, coach and athlete (Section 2.5.2). It must encompass the experiences of the athlete in both outdoor and expedition settings (Section 1.11.3). The data collected in these settings may differ and therefore a range of research methodologies may be required to collect data from these different settings.

4.11. Sport and Adaptive Sport

The use of APA in inclusive outdoor coaching and expedition leadership should be explored (Section 0), to contribute to APA research priorities. These include training, selection of coaches; technological advances; sociological and psychological aspects; similarities amongst disabled and non-disabled athletes; demographics of disability sport; legal, philosophical and historical aspects of sport (Section 1.5.1).

4.12. Functional Requirements

It is necessary to create a design outcome which can be self applied and/or self managed, for truly inclusive design, and athlete independence and acceptance (section 2.8).

4.13. Risk and Adventure

The research should help define reasonable risk in the outdoors with disabled people and explore the term reasonable when considering risk, safety and achievement for disabled individuals in the outdoors (Section 2.4.1). This may be achieved through supporting the development of inclusive fieldwork and out of classroom learning (Section 2.4.2), so supporting access to risk and adventure for disabled people (Section 2.4.3). It is through access to these opportunities that disabled athletes may be best able to explore their use of the outdoors, to create opportunities for personal development and understand their own risks (Sections 2.4.3 and 2.4.4). Overall this will provide a greater understanding of inclusive field practices (Section 2.5.1).

4.14. Performance of the Athlete

The research should utilise the body, boat, blade background and brain model of performance (Section 3.1). The final design should allow the user to utilise a range of self and assisted rescues and recovery in deep water (Section 3.5.1) and should promote the range of motion, efficiency and comfort of the performer (Section 3.6.3).

4.15. Equipment Performance Criteria

The equipment should be developed utilising observation (Section 3.1.3) and questioning, to evaluate live tests (Section 3.4.7).

It should have a range of performance criteria to promote the ability of the kayaker to:

- take responsibility for safety (Sections 3.5, 3.5.2 and 3.5.3)
- perform (Sections 3.5, 3.5.3, 3.1.1, 3.1.2, 3.1.3, 3.4.2, 3.4.7)
- be independent (Sections 3.4.7, 3.5.3)

The performance criteria also assist in the development of equipment that:

- takes into account the physical requirements of athletes with spinal cord injury (Section 3.2.1)
- is adaptable to different kayaks and environments (Sections 3.4.8, 3.5)
- is capable of withstanding 150 days of use (Section 3.3.1)

4.15.1. Seating and Posture

It is essential that the research promotes acceptance of the equipment by the disabled athlete (Section 3.2.2).

The equipment developed should enable a seating position with consideration for prescribed angles of flexion at the hips, lower back, knees and feet (Section 3.1). Not only should it address the overall seating position, but also the reduction of sheer under bony prominences, manage temperature, manage moisture (Sections 3.2.2 and 3.4.4), and provide a stable base for shoulder and arm movements to facilitate the generation of new or adapted techniques (Section 3.4.5). These factors should all be considered with particular regard to participation by athletes with the typical functional characteristics of paraplegics (Section 3.2.3).

The adapted FR test should be evaluated, in order to use it as a means of measuring whether the equipment improves the functional reach of the athlete (Section 3.2.3).

The research should utilise a core stability model to demonstrate how to support dynamic sitting, promote stability and reduce musculo-skeletal stress on the body (Sections 3.2.4, 3.2.8, 3.2.7, 0, 3.2.12), thereby adding to knowledge about posture (Section 2.5) and postural control (Section 3.3.3). It should consider both intrinsic and extrinsic factors that influence postural control (Section 3.3.3).

A fieldbased evaluation tool should be evaluated or developed, should consider frontal, saggital and transverse planes (Section 3.3.3), should consider both perceived and observed measures of performance and should ensure the equipment suits the task (Section 3.4.3).

The device needs to complete the Power Circles and Core Stability (Section 3.2.5).

The equipment should be able to be used in a variety of craft in club or independent scenarios and should be able to be manufactured by UK manufacturers in low batch volumes (Section 3.4.1).

4.16. Hypothesis

It is only possible to improve the performance of physically disabled athletes in canoe sport, through the development of appropriate seating systems in combination with broadening the understanding of canoe coaches.

4.17. Research Aim

To research and develop a specialist seating system for intermediate sea kayakers with spinal cord injury.

4.18. Research Objectives

- To work with a number of lead users in inclusive sea kayaking to identify user-wants in the area of sea kayaking for people with spinal cord injury

- To identify an appropriate method for the development of seating systems for people with spinal cord injury, through the co-ordination and observation of a multidisciplinary field trial involving coaches, therapists and lead users

- To identify the performance characteristics of sea kayakers with spinal cord injury, by observing the coach and athlete at work in both individual and group settings

- To work with a number of coaches and performers to develop a prototype seating system through a process of iterative design

- To identify the true nature of the performance enhancement through a longitudinal study of two sea kayakers with spinal cord injury

- To test a range of seating designs for sea kayakers with spinal cord injury through a series of field trials in the UK

- To evaluate the model of development and seating to provide a range of tools for the further development of adventure sports equipment for disabled people.

- To evaluate the model of development and seating to provide a range of tools for the further development of adventure sports equipment for disabled people.

5.

Chapter 5

Fieldwork - Risk, Team, Task, Planning and Leadership Considerations

5.0. Introduction to Fieldwork

The aim of this chapter is to ensure that the human and logistical elements of fieldwork are constrained, to ensure that data can be collected. If these elements are not constrained, data could become invalid. The chapter can be seen as a framework for field-based research activity that involves athletes in an adventure sport setting. The chapter reveals considerations for field-based teams when studying their own experiences, inspired by a design stimulus in a potentially dynamic environment. Methodological issues concerning the type and nature of questions and method of data collection are dealt with in Chapter six.

This chapter outlines the operational considerations for fieldwork which involves both disabled and non-disabled people, in the creation and collection of data in a field-based environment. In earlier chapters a range of themes that influence operational practice have been outlined.

Concept of risk and safety, field-based operational standards, fieldwork as research, and risk and access, are considered in sections 5.1-5.4. Section 5.5 considers issues for the individual, team and task. Fieldwork planning, programming and management are considered in Section 5.6. Combined together, sections 5.5 and 5.6 provide a justification for a fieldwork checklist. The checklist (Appendix D) will provide a process for helping to manage the influence of a team in data collection.

Chapter one established that the opportunity for disabled people to participate in sport across the performance spectrum continues to be restricted. This restriction means that there has been poor opportunity for the creation of safe and ethical field trial protocols. It is from this standpoint that I consider what appropriate fieldwork may be for this research. The focus is to ensure that from an ethical perspective the field trials are both physically and mentally safe for all participants.

Chapter two provided an ethical framework for this research and identified that the responsibility for ethics lies with the principal investigator. The fieldwork presents a range of ethical dilemmas for any fieldwork leader; risk, safety, opportunity, and meaningful engagement for individual participants.

Chapters three and four identified the current practices within sport, equipment, coaching and design and suggested that the inter-relationship between each of the paradigms needs to be managed to create a successful research outcome. These chapters suggested that successful fieldwork involves participants as a team of individuals from different disciplines, including coaches, designers and therapists, whose input to the research requires management, both in the field and as part of the mainstream design research activity.

5.1. Risk Hazard and Danger and Field based Operational Standards

The forthcoming section provides the definitions for the remainder of the chapter, defining concepts concerned with risk, hazard and danger.

Anderson and Johnson (2000, p.562), when considering health and safety on youth expeditions suggest:

> *'Risk means different things to different people. In this paper risk is defined as the probability of a hazard or incident to cause harm.*

Everything we do has an associated risk. Individuals perceive and react to risk differently. Anticipation, preparation and education reduce the probability that a hazard will become a risk. In summary, the findings of this study suggest that the health risks of participating in a well-planned expedition are similar to those encountered at home during normal active life.'

It is from this standpoint that I begin my exploration of health and safety.

Ogilvie (2005) provides a practical UK-biased perspective on the management of risk in the outdoors. He defines risk as something that causes harm, hazard as the likelihood of harm, and danger as the resultant effect. These need to be considered in relation to safety management.

Ogilvie (2005) goes on to suggest that the process of defining risk is known as a risk assessment. Risk assessment is defined by the Health and Safety Executive (2006), as shown Table 22. Risk assessment should be considered in relation to management and leadership, and Ogilvie (2005) suggests that safety management is more appropriate than the management of risk. He also introduces the concept of secondary risk, this being a process where a second party controls an individual's exposure to a hazard.

Table 22 HSE Five Steps to Risk Assessment (HSE 2006)

Step	**Activity**
Step 1	Identify the hazards
Step 2	Decide who might be harmed and how
Step 3	Evaluate the risks and decide on precautions

Step	Activity
Step 4	Record your findings and implement them
Step 5	Review your assessment and update if necessary

Additionally, Ogilvie (2005) suggests that risk can be quantified from a needs related perspective and can be experienced by an individual as; 1) physical survival, 2) physical security needs, 3) need for self esteem, 4) need for social security, 5) need for self identity. Ogilvie (2005, p.167) goes on to say;

> *'It should be apparent that the perception of emotional risk in a situation can be just as powerful or more in its effect on individuals in a group as is the possibility of physical hurt.'*

Ogilvie (2005) provides a seven-step model for individual risk-taking; 1) problem, 2) perception/assessment, 3) risk acceptance as part of the problem, 4) self-assessment (personal competency), 5) motivational assessment, 6) dissemination, 7) action.

When used in conjunction with models concerned with team processes, as described in section 5.5.3 of this chapter, it becomes possible to understand how disparities between individual and team perspectives on risk can evolve in a dynamic field-based situation.

It is from this quantifiable, humanistic, positive leadership framework or process that I start my understanding of field safety management.

5.1.1. Types of Risk; perceived, actual or emotional

This section outlines the types of risk that an individual may be exposed to in a field-based environment, identifying perceived actual physical and emotional risk.

Perceived risk and actual risk are often confused and amalgamated. For example, an abseil is for many a risky or scary business. However, when one undertakes the activity in a controlled environment with two safety systems, the actual risks are arguably minimal. Many potential participants are guided by media images and hearsay rather than by real fact.

Priest and Gass (1997) suggest that one activity can be viewed in a range of ways, dependent on different individual factors. Their model illustrates the need to consider both the physical and psychological requirements of the performer in their comfort zone and elicit meaningful feedback concerning their experiences. Emotional safety is about maintaining an appropriate level of perceived control for both individual and team. This involves short-term control, i.e. during the fieldwork phase, and long-term control, i.e. the consequences of the changed perception for the individual as a result of their involvement in their fieldwork.

Table 23 Module Handout, MA in Facilitation St Martins College, Ambleside, Richards (2002, p.1)

Self	**Time**
Negative self image Loss of control Loss of credibility Loss of empowerment	Prisoner of situation Too fast Interaction too deep Personal History

Self	Time
Embarrassment	
Interaction	Belonging Future
Loss of personal space Loss of control Personal insecurity Un able to contribute	Loss of credibility Dislocation Alienation Reliance Lack of support

Table 23 (Richards 2002, p.1) illustrates that the concept of emotional safety can affect the individual in terms of their experience of self, others, feeling safe and potential feelings in the future. A field trial is by its nature a step into the unknown and as such there is a need to create a framework which is able to mange both physical and emotional risk. Only by achieving this will it be possible to place the performer in their comfort zone and therefore elicit meaningful data.

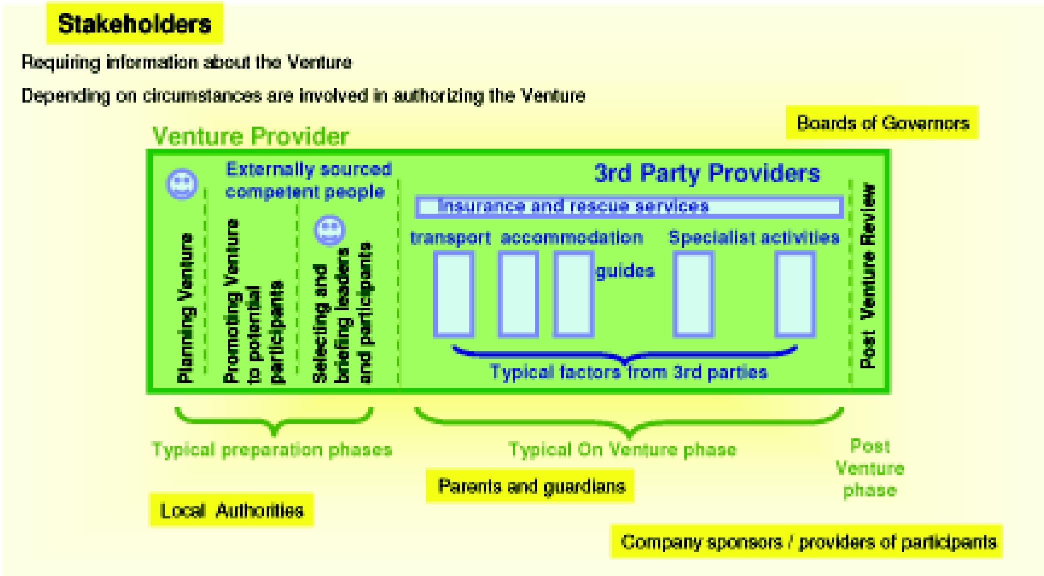
5.2. Operational Standards for Safe and Responsible Field Work and Outdoor Activity

I now review standards surrounding safe and responsible fieldwork. The organisation of outdoor activity in the UK has been codified following the Lyme Bay incident in 1993 and the resultant evolution of the Adventure Activities Licensing Authority (Hammond 2003). Additionally, Such and Eisenegger, (2007) suggest that similar incidents involving young people in youth expeditions have resulted in the development of standards concerned with overseas expeditions and fieldwork, such as BS8848 (British Standards Institution 2007).

BS8848 (British Standards Institution 2007, p.6) states:

> *'The crux of this standard is that the organization complying with it (i.e. the venture provider) is responsible for all elements of the venture. Elements can be delegated out but the accountability of ensuring compliance with this standard still lies with the venture provider. Where venture providers subcontract a significant part of the venture to a third party provider, compliance can be facilitated by the third party provider demonstrating compliance with the relevant clauses of this standard.'*

Table 24 The venture provider box (BS8848 British Standards Institution 2007, p.6)



NOTE The "venture provider box" is the responsibility of the venture provider who may choose to source people and services from others, i.e. the "third party provider boxes". The venture provider has the responsibility to check the capabilities of those elements factored into the venture from outside their own organization.

Table 24 illustrates the holistic approach required by a venture provider, who must become involved in more than just the basics of the specialist activity.

It is from this holistic approach that I see the management of safety for off-site field-based research, recognising that as stated by Peter Harvey, Director of Wilderness Expertise, in a conversation at Explore 2006 about the most likely site for an accident to occur, the most likely area for an incident during off-site activity is during the transfer of responsibility from one provider to another.

5.3. The Fieldwork experience as Research

The aim of this section is to illustrate the intense nature of fieldwork and suggest that the process of gathering information in the field places stresses on the team.

The connection between product development and expeditions has been established in Chapter 1. Expeditions can be seen as a method for capturing experience, which can be used for a range of purposes including product development. Brymer (2000) uses the action research model in his study of the Ganges 1998-99 River Expedition. In a study of an inclusive team during their five-month journey, he uses a model of action research to illustrate the link between the involvement in a research experience and a change in perception. Brymer (2000) also suggests that fieldwork by its very nature is a very intense experience, outside the realms of what could be considered a normal experience. It is reasonable to suggest that the leader of any fieldwork action research process or event needs to consider both the physical and emotional safety and capacity of all participants.

Brymer (2000) suggests that as a result of asking questions, participant awareness and views on reality are altered and therefore studying any team in the field creates additional intensity for that team. There is a clear need to consider when and how to capture field experiences in a manner which does not interfere with the true nature of the experience or overload team members, be they participants or researchers. It is clear that the research process within the fieldwork setting is a two way exchange, involving both the researcher and the participants,

The relationship between the researcher and the participants has a bearing on the validity of the data. If the participants are overloaded then their responses to the researcher's questions may be skewed. If the participants are interrupted during their experience then clearly there is no data to gather, because the participants have no experience to report. If the flow of performance is interrupted this will also skew the data, since it will alter the nature of the performance and the overall experience.

5.4. Risk and Access

In addition to the link to research ethics established earlier, this research can be seen against the backdrop of disability rights. Consequently the nexus between access and risk may be summed up as creating reasonable access to reasonable risk. This may require education and judgment on both the part of the researcher and the participant.

The Disability Rights Commission (2003) states that the relationship between the disabled community and risk is damaging to the rights of disabled people.

There is also an argument for access to risk for disabled people. According to Rose (2005, p.11):

> *'The saddest words are 'you can't' when you know you can – I am like a glass vase shut up in the cupboard where nobody sees me because everybody thinks I might break if they got me out. I don't want to sue anybody if I have an accident – I just want to get on with life.'*

Judge Gordon Ashton (1997, p.1-4) considers the dilemma of risk and access as follows:

> *'Our law must regulate the support provided for vulnerable people, but it may also need to protect and empower them […]. There is a conflict between empowerment and protection, because you cannot protect without taking away some of the rights that you seek to preserve.'*

Table 25 Continuum of Control and Power adapted from Tannenbaum and Schmidt (1958)

<table>
<tr><th>Passenger</th><th>Participant</th><th>Partner</th><th>Practitioner</th></tr>
<tr><td>Leader controls situation</td><td colspan="2">Leader is progressively less dominant</td><td>Leader is not needed</td></tr>
<tr><td>Individual is passive</td><td colspan="2">Individual progressively becoming competent</td><td>Individual is in charge of own destiny</td></tr>
<tr><td>Leader is directing and instructing</td><td>Leader is coaching</td><td>Leader is still supporting and mentoring</td><td>Leader has delegated or abdicated</td></tr>
</table>

I propose that safety management needs to be seen in the context of managing access. The Continuum of Control and Power (Tannenbaum and Schmidt 1958), outlined in Table 25, considers the inter-relationship between the individual and leader in a led activity. I see this model as a schema for the leader to manage their perception and the perception of the athlete, to develop a combined understanding of competency, access and exposure to risk.

From this perspective I consider that the role of the research leader, when working with individual disabled intermediate level athletes, is to manage the transition of the athlete during their journey to independence. This is a journey that may see the research leader redundant at the end of the process.

For the leader of a dynamic group of athletes who are shifting their perspective as they develop their capacity to take charge, there is a dilemma concerned with defining the point at which the athlete is competent to move from participant to partner to practitioner. This is illustrated by Ogilvie (2005, p.177) in his definition of the standard of care expected by leaders:

> *'The required standard of care is that which would be expected with the proper discharge of one professional duties and it increases as one becomes better trained and qualifications improve ones ability to foresee harm.'*

I suggest that any fieldwork must not only achieve the research task, but also increase the capacity of the participant to manage their own safety and develop their capacity to perform a task.

5.5. Individual, Team and Task

This section follows Adair's model of Individual, Team and Task. I take a person-centred approach and therefore consider the individual first. I then consider the team as a group of individuals. The end of the section considers what an appropriate task is for the inclusive adventure design fieldwork team.

5.5.1. Individual Optimal Performance in the Field

This section considers the nature of the experience for the individual, to identify what is an appropriate experience for the learner within the test or field environment, in order to balance safety, validity of the experience and the motivation of the performer. Mortlock (1984) suggests a three tier approach to levels of arousal in the outdoors; 1) recreational, 2) skill learning, 3) frontiers. Ogilvie (2005) cites Mortlock's taxonomy of experience (1984) to suggest that utilising risk-taking as a catalyst for development is often not appropriate.

Optimal arousal exists for each individual. Ellis (1973) believes that this is the point at which performance is at its maximum. Csikezentmihalyi and Csikezentmihalyi (1991, p.150) suggest that optimal arousal creates a state of flow;

> *'Flow describes a state of experience that is energising, intrinsically rewarding and outside the parameters of worry and boredom.'*

This suggests the following functional characteristics; 1) immediate feedback, 2) action and awareness merge, 3) screening or limited stimulus field, 4) heightened awareness of inner workings.

It is clear from this section that there is a need to ensure that any observed or recorded experience is programmed to create a flow experience for the participant. It is also clear that the creation of flow experiences requires the balance of a range of factors; task, environment and equipment.

5.5.2. Field Based Experimentation and its effect on the individual

The aim of this section is to consider the implementation of long-term trials, where the capacity of the individual and team may change during the activity.

Competence is defined by Priest and Gass (1997, p.19) as;

> *'… a combination of skill, attitude, knowledge, behaviour, confidence, and experience. As with perception of risk, each adventurer has a perception of personal competence that may or may not be accurate.'*

I propose to use a model of competency to explore how the individual may change as a result of the stresses placed on them by the field experience.

Table 26 Developing Competence, Dienhoven (2000, p.12)

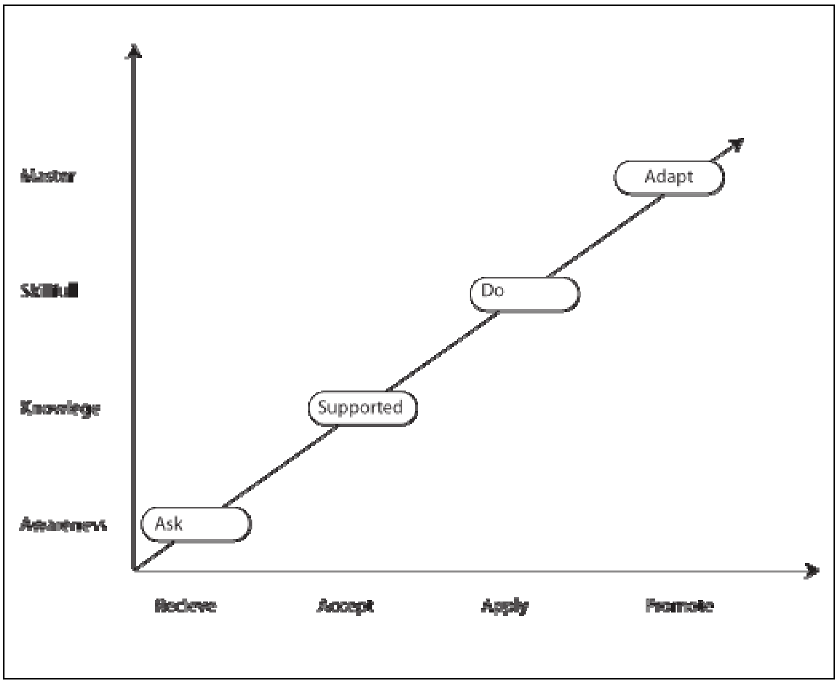


Table 26 (Dienhoven 2000, p.12) illustrates that as an individual's competency develops, so does their ability to work in a greater range of scenarios, until they are able to adapt their previous experience. In a fieldwork environment the need is to ensure that members of the team, be it leaders or participants, have the relevant competencies to be able to cope with the environmental factors, with the given resources and the stated level of support from within the group.

For research and new knowledge to be created, key individuals involved in the process need to be highly competent in the chosen operational environment, in order to be able to engage in debate, as well as adapt and create new knowledge and understanding. Mastery allows the researcher to adapt the present and create visions, or plans of new horizons and realities beyond the day-to-day.

Creating mastery for the athlete must increase their ability to contribute to a people-centred development process. The objective for the researcher is to create the possibility of change in performance of the team and the equipment. In this context the team and the equipment are dynamic, so the researcher must understand how individuals react to change. The result could be that the participant within the research process could change in their ability or competence to cope with an environment. I suggest that Howell (1982, p.29-33) provides a framework for the dynamic nature of an individual's level of competence when taking on a new or challenging experience;

> *'Unconscious incompetence - this is the stage where you are not even aware that you do not have a particular competence. Conscious incompetence - this is when you know that you want to learn how to do something but you are incompetent at doing it. Conscious competence - this is when you can achieve this particular task but you are very conscious about everything you do. Unconscious competence - this is when you finally master it and you do not even think about what you have such as when you have learned to ride a bike very successfully.'*

It is clear from this section that the previous linear model of competence (Dienhoven 2000) should be more dynamic. Howell's model (1982) is therefore where I start my understanding of the dynamic nature of performance for the athlete.

Priest and Baillie (1987) suggest a link between competence, adventure and risk, suggesting that high risk with low competence leads to devastation or disaster. As the individual's competence increases they move from devastation to misadventure, peak adventure, then adventure, gaining the capacity for exploration and experimentation.

Priest and Gass (1997, p.49), as illustrated in Table 27, suggest that an individual's perceived and actual level of competence are not always in tune, nor do they have an ability to quantify the hazard in an environment. It leads to the concept termed Adaptive Dissonance, which has a range of consequences depending on the motivational state of the individual.

Table 27 The nine types of individuals, based on perceptions of risk and competence, Priest and Gass (1997, p.47)

<table>
<tr><td rowspan="5">R
I
S
K</td><td colspan="4">Competence</td></tr>
<tr><td></td><td>Over Perceived</td><td>Correctly Perceived</td><td>Under Perceived</td></tr>
<tr><td>Under Perceived</td><td>Fearless and arrogant</td><td>Bold</td><td>Naïve and innocent</td></tr>
<tr><td>Correctly Perceived</td><td>Assured</td><td>Astute</td><td>Insecure</td></tr>
<tr><td>Over Perceived</td><td>Carefree and exaggerated</td><td>Overawed</td><td>Timid and fearful</td></tr>
</table>

According to Priest and Gass (1997), ethical adventure programmes debrief/review individuals and groups to help them reflect on their past experiences and encourage them to reassess their perception of risk and competence. Managing perception of risk and competence to ensure that an individual maintains an appropriate level of adventure is a critical activity for the leader/researcher. Due to their greater level of technical knowledge and awareness, the leader/researcher has a higher duty of care.

5.5.3. Teams as individuals in a group process

This section reveals the inter-relationship between individuals in a group, considering the group as part of the research mechanism. The aim is to identify and consider the ‘flow’ state for the group or team, to ensure that the nature of the data is not changed by individuals within the group. This includes maintaining the safety of each individual at every level, from physical to emotional.

In this section I look at group formation, as a way of identifying when the group dynamics may interfere with the transactional process between the researcher, coach and participant.

Brymer (2000) suggests that there is little information on the expedition team processes, but states that there are two ways of looking at team processes; outputs and throughputs. Brymer (2000, p.109) concludes that the most important factor influencing the success of an expedition is an understanding of an individual's values and beliefs;

> *'Individual identities values and beliefs are understood. When this is done relevant shared values can be aligned. The next step would be to ensure that the emotional conditions are met. Only when these aspects are in harmony is it when the team is ready to function as a unit.'*

Heron (1999) states that there are three common anxieties to joining a group which are concerned with; competence – can I do what is being asked, acceptance – will I form relationships, understanding – will I be understood and will I understand.

Brymer (2000) suggests that understanding team values is vital to the success of a field project. He suggests that it is also important to clarify the goals of an expedition in order to maintain harmony within the team and quality of research. The expedition format often provides individuals with the opportunity to explore the relationship between their comfort zone and their adventure zone of experience.

5.5.4. Group Formation and Timing of Research Activity

Tuckman and Jensen (1977) suggest that there are different stages of group formation. Table 28 provides a model which defines the focus of the group and its leader during different stages of its development.

It is clear from Priest and Gass (1997) that the timing of the research in relation to the research group formation may have a bearing on the validity of the data generated. This needs-based approach is described by Ogilvie (2005) as people-centred.

This suggests that the term has an optimal flow state. For the researcher, this means that the timing of the research phase in the fieldwork should be deliberately in tune with the group process.

Table 28 COLT – Conditional Outdoor Leadership Theory Leadership styles appropriate for group development, Priest and Gass (1997, p.65)

Stage of Group Development (Tuckman and Jensen 1977)	Task Dimension	Relationship Dimension	Leasers concern for task vs relationship	Conditional leadership style (Priest and Chase 1989)
Forming	Acceptance Independence	Acceptance Independence	High vs Low	Autocratic
Storming	Resistance Confrontation	Rebellion Conflict	High vs High	Democratic
Norming	Compliance Involvement	Cohesion Intimacy	Low vs High	Abdicratic
Performing	Productivity Competence	Pride Commitment	Low vs Low	Democratic
Adjourning	Termination Separation	Transformation Satisfaction	High vs Low	Autocratic

5.5.5. Task – What to test in the field

This section provides a start-point for understanding what is to be tested in the field. One of the key elements of safety suggested by the Adventure Activities Licensing Authority (AALA) Regulations (1996) is the ability of all members of a party or group participating in an activity to understand their role and position within the environment. Part of the environment is the equipment. The AALA (1996, p.30) outlines the importance of recognising responsibility for equipment;

'If you hire the equipment it does not change the responsibility which you have of ensuring that it is safe, functional, and in good order.'

From this standpoint it is clear that there is a need to ensure that during the practical testing of equipment responsibility is organised. The prototypes presented to the participants must be safe, functional and in good order. Any practical testing in the design research programme needs to be such that the safety of the participants is maintained.

I suggest that Ogilvie's (2005) model of primary and secondary risk taking is relevant here also. The researcher should present items for test that the user or tester is competent to understand in terms of the risks inherent within that equipment. The participants are then taking more primary based risks.

5.6. Plan and Programme, and Lead and Manage

In this section I look at the role of the leader in planning and programming, and leading and managing.

I look at the importance of setting a programme that allows participants to participate at a level with which they are comfortable. This may involve managing an individual's understanding of risk, to reduce the level of secondary risk-taking.

I then consider how leaders need to manage team, task and individual factors in a manner that allows everyone to contribute. I explore the learning aspects of leading and discuss the need for the leader to expect the unexpected. They are then able to manage the needs of an inclusive team and help it develop creative solutions to any problem it may encounter, without damaging the emotional or physical safety of the individual. I consider the need for the leader to manage the team in a manner that enables it to reach a flow state at the earliest opportunity. I outline facilitation techniques and suggest that these may be appropriate for the leader of a learning team.

5.6.1. Adventure Planning and Programming

This section outlines components of adventure planning and programming. The aim of planning is to reduce the risks, manage the team inter-relationships and create opportunities for optimal performance.

Expedition planning is defined by Winser (2004) as a balancing act between four factors; who (how many members?), time (how long in the field?), cost (cost per person), and purpose (expected work each day). He goes on to suggest that the aim and objectives of the expedition should balance these criteria to create a successful field-based project.

Priest and Gass (1997, p.46) utilise Mortlock's taxonomy of adventure (1984), given in section 5.5.1, and state that;

> *'Ethical adventure programming deals with the conditions up to and including misadventure, because people learn well from their mistakes. But devastation and disaster are not purposeful part of ethical adventure programs.'*

The aim of good programming should be to ensure that all participants are able to participate in a given activity or task with their full understanding and consent. Programming should therefore manage both primary and secondary risk (as discussed in section 5.1), whether it be actual or perceived, physical or emotional.

I suggest that the length of the field trial needs to be sufficient to allow participants and the team to reach their flow state, in order to allow true data to be revealed without being biased by team or individual factors.

5.6.2. Leading and Leadership

This section considers the inter-relationship between the individual, the team and the leader in the field, distinguishing between leaders and the process of leadership. The section considers how the leader's actions create a bias for data collection. It provides models to identify leadership styles and priorities in the field, and recognises that field-based leadership is a dynamic activity, allowing individuals and team to engage with issues of 'adaptive dissonance' (Priest and Gass 1997), within the fieldwork programme.

Previous sections of this chapter have identified a range of issues which must be managed through and by the leader; risk, planning, adventure programming, team, task and individual requirements. It is clear that regardless of any preparation, there is a need to consider the role of the leader in the fieldwork environment, in terms of their role in the research and their role in the group. To achieve this there is a need to consider some of the key concepts and definitions surrounding field leadership.

The aim of this section is to explore the dilemmas and influences that the fieldwork leader needs to reconcile, or manage, in order to manage the needs of the team, task and individuals.

Ogilvie (2005) suggests that the character of the leader has significant effect on the experience of the group, stating that it is the leader's responsibility to temper their approach to meet the needs of the team, task and individuals.

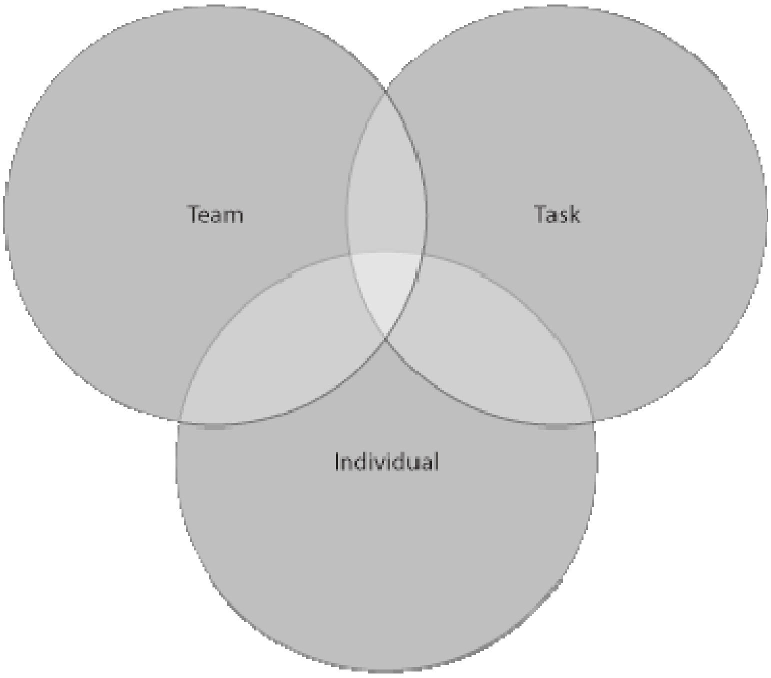


Figure 31 The classic model of Leadership – John Adair (1983)

Ogilvie (2005) suggests that most people who lead groups hope they will make a difference to the lives of the people that they lead and are faced with the need to resolve a paradox concerned with risk. He goes on to suggest that leaders need to be aware of their own natural style and develop their own frameworks for dealing with the paradox of leadership. I suggest therefore that the commonly used model by Adair (1983), shown in Figure 31, must be conceptualised within a social context by those leaders wishing to lead groups who may be marginalised by society. This includes groups of disabled and non-disabled people. The adapted model by Paul (2000, p.20), shown in Figure 32, prescribes the external pressures on the team task and individual, framing the leadership paradox described by Ogilvie (2005).

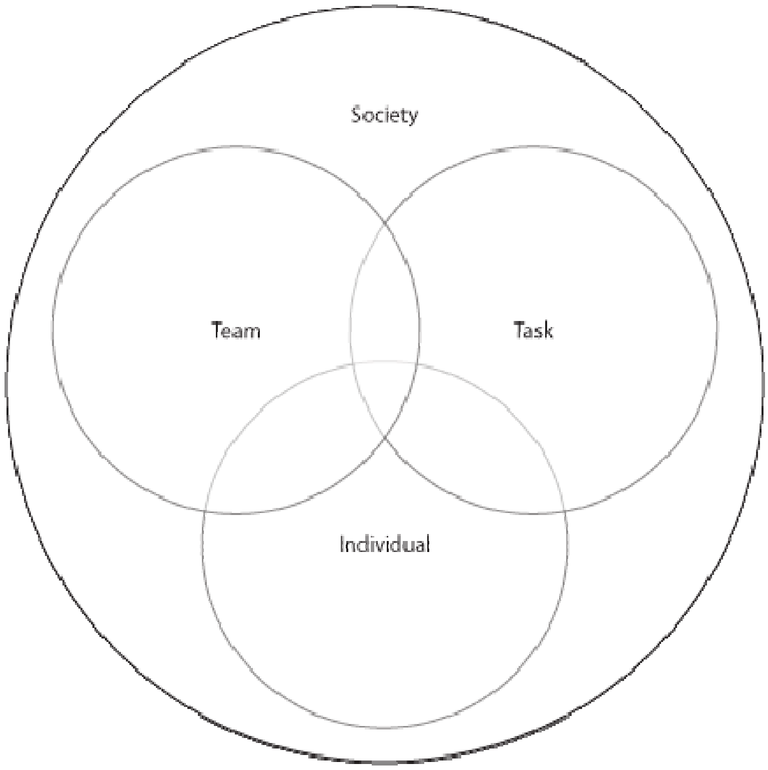


Figure 32 Team Task Individual in Society, Paul(2000, p.20)

Tozer et al (2007) suggest that leadership requires people taking positive learning steps, requiring them to work flexibly with others. Tozer et al (2007) suggest that a holistic approach to leadership includes applying skills, values and motivations into leadership. They suggest that it is possible to apply Perkins, Jay and Tishman's (1993) 'good thinking dispositions' to leadership; adventurous, curious, understanding, strategic, intellectually careful, critically evaluative, meta-cognitive. I consider this as a theoretic start-point for mapping what the characteristics are of highly flexible inclusive leaders. Tozer et al (2007) conclude that adaptive experts expect the unexpected; this is the key to inclusive leadership.

Ogilvie (2005), and Priest and Gass (1997), suggest that the degree to which the leader is task or people-centred depends on five factors; degree of environmental danger, level of individual competency, degree of group unity, leader's level of proficiency, degree of seriousness consequent upon a decision. Priest and Gass (1997, p.242) provide an illustration of this dynamic approach in the Conditional Outdoor Leadership Theory (COLT), as shown in Figure 33.

For the outdoor researcher whose aim is to observe independent true flow-state performance in the outdoor environment, the need is to understand the role in which the leadership style is going to shape the experience of the participant. Managing the factors outlined in the COLT model (Priest and Gass 1997, p.242) must therefore be a high priority for the outdoor leader/researcher. The aim of the leader is to become in tune with the team, task and individual, to manage their own flow state.

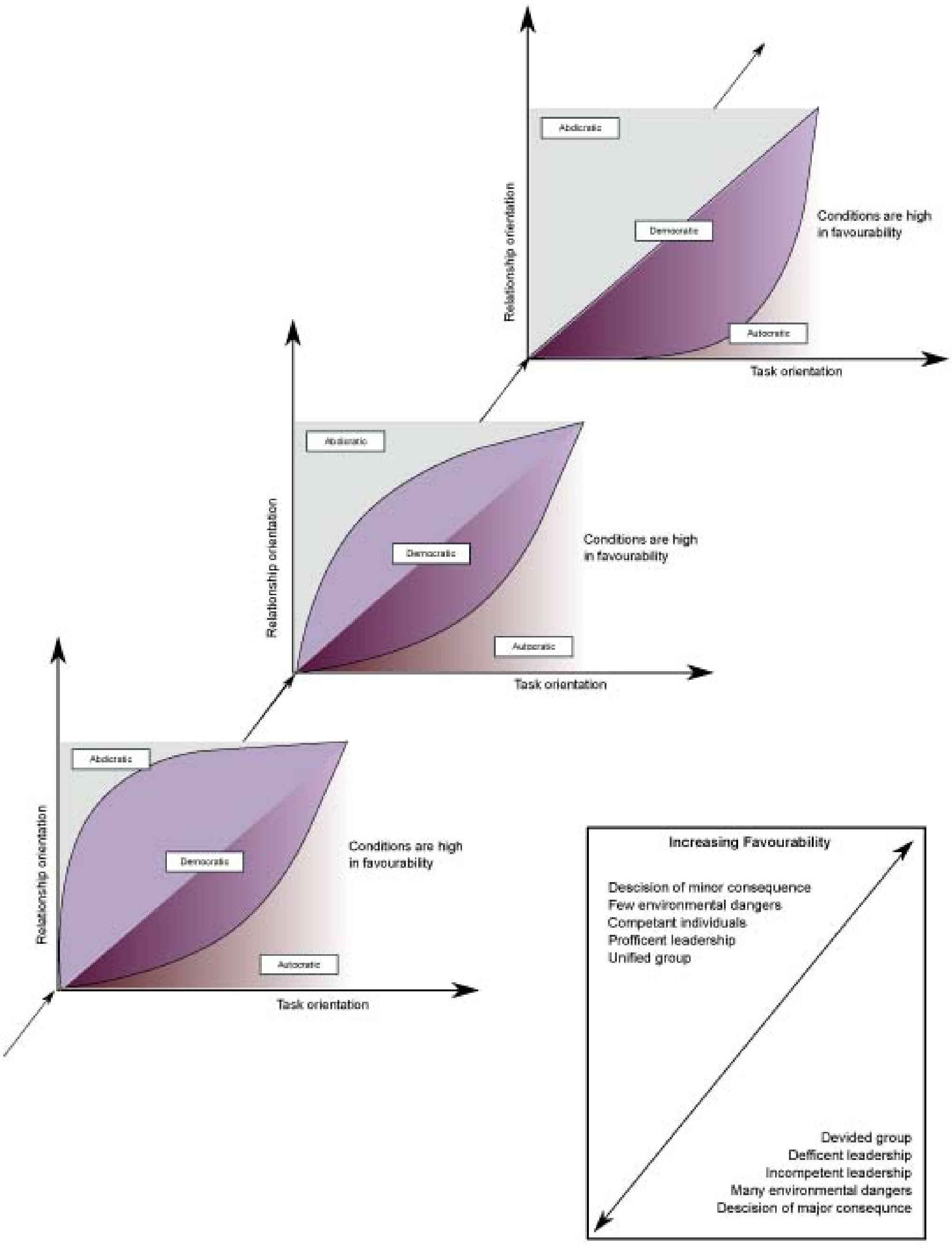


Figure 33 The Conditional Outdoor Leadership Theory (COLT), Priest and Gass (1997 p.242)

5.6.3. Leading as a Method of Managing Group Learning

The aim of this section is to link leadership to learning for both the leader and the group member. Creating this link makes it possible to support collaborative approaches for meaningful field-based research opportunities.

Heron (1999), a humanistic psychologist, developed a model of the six types of intervention a doctor, counsellor or therapist could use with a patient or client: prescriptive, informative, confronting, cathartic, catalytic, supportive. According to Little (2001, p.1), as illustrated in Table 29, these types of intervention have been developed to suit the needs of group facilitators, to form the basis of a framework for facilitation in a small group situation.

Table 29 The Origins of Heron's Approach to Facilitation, Little (2001, p.1)

Heron's Therapeutic Approach	**Little's Facilitation Approach**
Prescriptive	Planning
Informative	Meaning
Confronting	Confronting
Cathartic	Feeling
Catalytic	Structuring
Supportive	Valuing

Heron (1999, p.6-7) presents three modes, which can be flexibly employed by the facilitator in order to match the needs of the group; hierarchical, co-operative, autonomous. The characteristics are summarised in Table 30.

Table 30 Modes of Facilitation (Heron, 1999, p.6-7)

Hierarchical	Cooperative	Autonomous
Trainer plans but does not really negotiate	Trainer negotiates and coordinates planning	Trainer delegates planning
Trainer inputs theory, interprets and assesses	Trainer asks neutral questions (eg What is happening now?), uses descriptive feedback and negotiates assessment	Trainer uses reflection Group self-assesses and self-analyses Trainer may even delegate this role
Trainer interprets and may even describe block Trainer decides how feelings are managed and thinks for the group	Trainer describes events and asks for views on avoidance	Trainer provides environment that is safe
Trainer gives permission for catharsis	Trainer works with the group to develop ways to cope with feelings	Trainer gives space to manage feeling
Trainer takes over the design and supervision of the learning process	Trainer cooperates to let rules emerge using counselling skills	Trainer delegates design
Trainer uses actions and commitment. i.e. charisma		
Trainer has positive regard for others	Trainer collaborates to allow self-respect and favourable climate to emerge	Trainer lets the group determine its own climate Makes self-disclosures on values

I see this as a link to managing learning in the outdoor environment for both the individual and the team. I suggest the following summary from Middleton and Field (2001) as a map for understanding the matrix betweens Heron's (1999) dimensions and modes.

Table 31 Facilitation (Middleton & Field 2001, p.153-4)

Dimensions	**Hierarchical Mode**
PLANNING - To do with the programme and learning objectives. Also include Assessment and the Evaluation of Course/Facilitator. Dilemma - "Need to guide people to freedom".	You plan the whole programme, including: Time, Topics, Resources, Methods May consult group but not negotiate.
MEANING - To do with making sense of, and understanding what's going on in the learning group, in the three areas of: The task, The process of the group, The learning process	You input the theory i.e. the concepts & images You interpret, and You assess what's going on
CONFRONTING Raising awareness about blocks to learning in the group. Anxieties, Ignorance, Limited learning Objectives, Cultural oppression, "Easy Street" The issue being avoided, the behaviour to do this and the source of the behaviour "Tell the truth with love and not moralistic judgment, oppression or nagging".	You interrupt things and interpret for the group May describe the block to the group
FEELING - The management of feelings i.e. the emotional life of the group. You aim to identify negative emotional processes, interrupt them and change to positive emotional process. By acknowledging that positive and negative are always	You decide how the group will manage feelings you think for the group and decide on action e.g. switching dynamics with games, exercises, ceremonies for opening and closing. You give permission for catharsis.

Dimensions	Hierarchical Mode
present you are concerned with getting the balance right.	
STRUCTURING - To do with structuring of learning experiences: The environment and methods. Also the supervision of these. There is "Here and Now" part of planning a course, i.e. details of the course design.	You take responsibility for design and supervision of exercises. Pre-course you organise programme, rooms, resources, fee, group composition. You set the ground rules, purpose of exercise and review them yourself.
VALUING - To do with creating a climate of respect for people. Members feel valued and honoured.	Your actions and commitment to valuing people direct the group. You decide ground rules that support this, and have positive regard for people. You are actively charismatic i.e. exhibit "distress-free" authority. Very important in early stages of a group.

Dimensions	Co-operative Mode
PLANNING - To do with the Programme and learning objectives also include Assessment and the Evaluation of Course/Facilitator. Dilemma - "Need to guide people to freedom".	You negotiate and co-ordinate the learning contract. You may present your programme and ask for their views or …. May ask the group to provide programme for discussion.
MEANING - To do with making sense of, and understanding what's going on in the learning group, in the three areas of:	You ask neutral open questions to stimulate the group e.g.: "What is happening now?" You describe events without

Dimensions	**Hierarchical Mode**
The task The process of the group The learning process	interpretation You collaborate and negotiate an assessment
CONFRONTING - Raising awareness about blocks to learning in the group. Anxieties, Ignorance, Limited learning Objectives, Cultural oppression, "Easy Street" The issue being avoided, the behaviour to do this and the source of the behaviour "Tell the truth with love and not moralistic judgment, oppression or nagging".	You ask for views from group on their avoidance of: Issue Behaviour Source May describe events.
FEELING - The management of feelings i.e. the emotional life of the group. You aim to identify negative emotional processes, interrupt them and change to positive emotional process. By acknowledging that positive and negative are always present you are concerned with getting the balance right.	You work with the group on different ways of managing feeling. e.g. by getting the view of the members and then negotiating changes, new methods etc. You may work 1:1 with a member rather like a counselor.
STRUCTURING - To do with structuring of learning experiences: The environment and methods. Also the supervision of these. There is "Here and Now" part of planning a course, i.e. details of the course design.	You co-operate with the group on ground rules, exercises and review of things. You use a range of skills here akin to counselling and consulting.

Dimensions	**Hierarchical Mode**
VALUING - To do with creating a climate of respect for people. Members feel valued and honoured.	You collaborate with members as they develop, respecting self-determination. You give the choice of doing something or not. You collaborate with the group to create a favourable climate. By co-operating with the other 5 dimensions, you are valuing people.
Dimensions	**Autonomous Mode**
PLANNING - To do with the programme and learning objectives also include assessment and the evaluation of course/facilitator. Dilemma - "Need to guide people to freedom".	You delegate to the group. May operate as a peer, or a facilitator or even NOT AT ALL if they are you to leave. N.B. The dilemma:- "Need to guide people to freedom".
MEANING - To do with making sense of, and understanding what's going on in the learning group, in the three areas of: The task The process of the group The learning process	You allow members of the group to reflect and reach understanding themselves. May delegate this to a group member.
CONFRONTING - Raising awareness about blocks to learning in the group. Anxieties, Ignorance, Limited learning Objectives, Cultural oppression, "Easy Street" The issue being avoided, the behaviour	You provide a safe, supporting and trusting environment to allow the group to confront for itself. May delegate the confronting role e.g. have a "devil's advocate" rule.

Dimensions	**Hierarchical Mode**
to do this and the source of the behaviour "Tell the truth with love and not moralistic judgment, oppression or nagging".	
FEELING - The management of feelings i.e. the emotional life of the group. You aim to identify negative emotional processes, interrupt them and change to positive emotional process. By acknowledging that positive and negative are always present you are concerned with getting the balance right.	You give the group space to manage its own feeling, e.g. by working in pairs/trios. You may delegate this to a member in turn.
STRUCTURING - To do with structuring of learning experiences: The environment and methods. Also the supervision of these. There is "Here and Now" part of planning a course, i.e. details of the course design.	You give space to the group to devise and manage its own learning. You delegate design, choice and review to the group. You may become a peer member or even leave the group.
VALUING - To do with creating a climate of respect for people. Members feel valued and honoured.	You create space for the group to exercise autonomy and self-determination. You may delegate facilitation to a member. Make self-disclosures about your beliefs, attitudes, feelings, anxieties and delights

This section demonstrates that facilitation, as presented by Heron (1999), can be used in a clinical setting and has been evolved for facilitators, as illustrated by Little (2001). I therefore propose that facilitation provides a framework for the inclusive sports equipment designer who seeks to straddle clinical, outdoor and sporting paradigms.

5.7. Chapter Conclusion

Risk means different things to different people, and can affect all elements of the human experience. It can be quantified through a process of risk assessment.

Positive approaches to risk concern themselves with the management of safety. Operational standards provide a holistic approach to safety management. Planning within a safety management framework creates the capacity for additional stresses or tasks to be placed on the team in the field.

When considering the relationship between access and risk, it is necessary to balance empowerment and access against primary and secondary risk taking. Individuals should be encouraged to develop their capacity to understand both the field environment and the activities which they propose to undertake, in order to reduce their amount of secondary risk taking. This process takes the participant from passenger through partner, to independent practitioner.

Leadership frameworks provide the structure to help the participant manage the intensity of their field experience. From a programming perspective the aim must be to create optimal arousal or flow for both team and individual. From an individual perspective this may require the management of dissonance between the actual and perceived level of competence and risk that the performer understands. Debriefing or reviewing may support the performer's competence and self knowledge, to help them gain a truer picture of their performance.

From a team management perspective, managing individual values and priorities, and balancing team, task and individual needs will help the team get into its own flow state, so that it becomes possible to gather more accurate data. In terms of leadership focus, it is anticipated that the leader will change their priority as team cohesion develops and the team matures.

When selecting what to test, again the balance between primary and secondary risk taking can be used as a model for identifying what is an appropriate task. From a leadership perspective, the concept of 'adaptive capacity' (Tozer et al 2007) provides a useful tool to help leaders work with participants using a partnership approach, to gain a measure of what an appropriate challenge may be.

6.

Chapter 6

Methodology: A Review of Approaches to Inclusive Outdoor Equipment Research

6.0. Introduction to the Methodology

This chapter outlines the methodology for the creation of sea kayak seating for intermediate performers with spinal cord injury. The chapter is drawn from methodologies from the paradigms of outdoor education and social science.

The chapter describes a philosophical standpoint for the research, which creates a bridge between research and design in section 6.1, to fit with the leadership and facilitation perspectives described in chapter five. Data management is described also in these terms to provide clarity between observation, analysis and creation (see section 6.2). Section 6.3 considers the ownership of the data creating in the design process. The techniques used to gather data are presented in section 6.4. The case study format of the studies is described in section 6.5, leading onto an outline of the study mapped onto a seven level inclusive design process. The chapter concludes with a research plan which outlines each study. A detailed description of the application of the proposed methodologies is given in the introduction to Appendix F.

Chapters one to five reveal a number of themes which have relevance to the methodology. It suggests that the methodology should facilitate working with a disadvantaged community in a safe and responsible manner, in order to create knowledge that is able to span disciplines to codify the resources available to disabled adventurers. Additionally the literature review suggests that any methodology should have a fit with the field work setting.

Chapter one illustrated that disabled people could be considered to be a disadvantaged community in the realm of outdoor physical activity. Chapter two considered the ethics of the study in terms of the resources utilised and the responsibility of safe ethical inclusion by the research leader. Chapter three outlined current thinking in the areas of outdoor sport, disability and equipment, suggesting that the outdoor industry has become increasingly codified, inclusion in sport can be seen as a process and the acceptance of rehabilitation equipment by disabled people is a key issue in the overall experience of the disabled user when utilising a new piece of equipment. This chapter concluded by illustrating a range of current solutions, most of which suggest that there are no production items for intermediate sea kayakers with spinal cord injury. Chapter four analysed in detail the content of chapters one-three, providing a range of research areas which need to be addressed. The areas fall broadly into the following categories: Process and method, Opportunity and inspiration, and Technological.

Chapter five revealed issues to do with adventure planning and programming and particularly risk. The connection between leading and facilitation was highlighted when working with a team in the field whose key objective is to learn from their own experience.

This chapter outlines the key methodological dilemmas and approaches, and illustrates the techniques proposed by the researcher for use during field-based studies.

I suggest that it is necessary for me to reconcile approaches from design, disability, outdoor education, fieldwork and sport. I suggest that the key requirement is to gain a true understanding of the needs of disabled outdoor athletes in order to inform a design process.

Allen (2002) stated a number of difficulties he experienced when gathering data from young disabled users of a communication device, as part of his attempt to follow a user-centred design approach in his research. He suggests that there can be a dual view of the research objectives and that there is a need to match the opinions of the researcher with those of the participants. With regard to the design of equipment for disabled people Allen (2002) argues that solutions are often engineered and not designed, assisting with function, but not always dealing with the emotional needs of the disabled user.

With regard to research method Allen (2002) suggests the need to consider group organisation, communication and understanding. He highlights the need to not only observe, but get involved with the participants and utilise a number of different methodologies during different stages of a design research cycle. Only this way he suggests is it possible to bridge the gap between what the user says they wants and what they really mean. From a logistical and human resource perspective Allen (2002) suggests that interviews can be physically and emotionally demanding for both the interviewer and the interviewees.

I therefore suggest that there is a need to take a multi-dimensional approach to data collection to ensure that it is possible to view a phenomena from as many perspectives as possible and to be mindful of the resource and logistical restraints of the research in order to maintain the health and wellbeing of both the participant and the researcher.

6.1. Critical Ethnographic Approach

This section considers critical ethnography in relation to field-based, people-centred design research.

Ethnography can be situated within a politically conservative tradition, characterised by a researcher who adopts the stance of a “disinterested researcher" (McQueen & Knussen 2002). For the purposes of this research task I cannot adopt a position of 'disinterest'. My role as a designer involves me being intimately engaged with the abilities and aspirations of the participant/learner for whom I am designing equipment, as well as requiring me to engage completely with the design problem itself.

Ethnography has historically been used as a research tool in anthropology. The role of the ethnographer is to draw a detailed picture of the social experience of people. According to Marcus and Fisher (1999), interpretative ethnographers are more interested in problems of cultural meaning than in creating social action.

Critical ethnographers, by contrast, accept an added research task of raising their voice to speak to an audience on behalf of their subjects. According to McQueen & Knussen (2002), they do this as a means of empowering the subjects, giving more authority to the subjects. As a consequence, critical ethnography proceeds from an explicit framework that, by modifying consciousness or invoking a call to action, attempts to use knowledge for social change.

McQueen and Knussen (2002) go on to explain how conventional ethnographers study culture for the purpose of describing it; while critical ethnographers do so to change it. Conventional ethnographers recognize the impossibility, or even undesirability, of research free of bias. They believe that this bias should be reduced. Critical ethnographers, as also stated by Thomas (1993), instead celebrate their normative and political position as a means of invoking social consciousness and societal change. This is similar to the way in which designers work – collecting data, adjusting it, representing it, evaluating it – an iterative process until a successful design outcome is reached and the need for adjustment is no longer required. As discussed in Chapter 2.8.1, design is an agent of social change and the design process can influence social consciousness. As explored in the methodologies in this section, the need is to engage with the collective consciousness of the group of individuals as part of the design process. In short, I am adopting a stance as a critical ethnographer, as opposed to a conventional ethnographer, during this user-centred design study.

This nexus between a critical ethnographic approach and the design study is emphasised in the assertion that critical ethnographers use their work to aid emancipatory goals and prevent repression of their subjects. According to Thomas (1993, p.4):

> *'Emancipation refers to the process of separation from constraining modes of thinking, or acting, that limit perception of and action toward realizing alternative possibilities. Repression is the condition in which thought and action are constrained in ways that banish recognition of these alternatives.'*

Given that the study has thus far revealed a distinct lack of opportunity for disabled people in this area of society, I see the proposed research to have emancipatory goals.

I see my research from this multi-dimensional standpoint and propose to use three methods during the research; ethnographic or observational, action research, and emancipatory or participatory research. McQueen and Knussen (2002) suggest the definitions shown in Table 32.

From a design perspective, taking a multi-dimensional approach allows for the researcher to learn about the situation through observation in stage one. In the second stage I propose to take an action research approach, acknowledging my input in the direction of the research process. During the third stage of the process, where observation is required to be evolved into action or creation, then the design innovation cycle could be considered as the emancipatory driver to the research.

Table 32 Qualitative Research Approaches, adapted from McQueen and Knussen (2002, p.196-213)

Approach	**Summary**
Ethnographic or observational	Present the world view of the group or form a holistic in-depth, holistic analysis of the structure and processes of this phenomenon.
Action research	Identify the problems in particular settings, generating hypotheses about the causes and cures, acting on these and evaluating the impact.
Emancipatory or participatory research	Participants take a central role and are involved to a greater or lesser extent in setting the research agenda, reducing the possibility of exploitation, but potentially increasing the challenge for management of different agendas. This approach provides scope for 'out of the box thinking' but may provide too many alternatives for working with communities with finite resources and a requirement for both research and pragmatic outcomes.

From a sporting or coaching perspective, this three-stage approach allows me as the researcher to initially act in a passive manner, to observe performance. As the study and my understanding of the participants' or performers' requirements develops, I am able to take a more proactive stance to help develop performance with the participants. In the observational stage I am able to observe participant, coach and therapist techniques, in the action research stage I am able to trial the knowledge gained from stage 1, and finally in the emancipatory stage I am able to observe the application and guide new participants and practitioners, using knowledge gained in the first two stages.

Given the intense nature of the proposed fieldwork, I anticipate there to be a number of ethical dilemmas resulting from this multi-dimensional approach. These include the use of potentially negative or high intensity experiences to create data, the use of fieldwork where it may be difficult not to get involved, and my organisational role in the research as fieldwork leader requiring me to control the elements of fieldwork safety.

6.2. Data Management

I take a ‘phenomenological’ standpoint in terms of data manipulation, as described by Miles and Huberman (1994), as I gain practical understanding of meanings and actions. According to Miles and Huberman (1994), phenomenology is a process of observing something that is happening.

During the design phase of the research I suggest that I will take an ‘interpretivist’ perspective on the research. Miles and Huberman (1994) explain interpretivism to involve a process of enquiry, about the theory behind the facts. I suggest that at this stage the research is a collaborated act between both the researcher and the participant.

Miles and Huberman (1994) point out that even before data collection begins, ‘anticipatory data reduction’ occurs. I suggest it to be especially true of this research, given the requirement for the fieldwork to be meticulously planned in order to maintain safety. It is also true as the gathering of resources requires a justification, and will necessitate the development of questions prior to the commencement of fieldwork.

Data display refers to organising and compressing information in a way that permits conclusion drawing and action. I anticipate that this process of organising data and making a connection between various stories will bridge the gap between observational and interpretivist approaches, moving from data to design.

Miles and Huberman (1994) assert that extended text quickly overloads humans' information processing capabilities. They advocate other types of displays, such as matrices, graphs, charts and networks. In this way the analyst can see what is happening and either draw a justified conclusion or move on to the next step of the analysis. Again I see that this is key for the designer in a research project, as it helps to define the nexus between data and creation, research and design.

Miles and Huberman (1994) suggest that to draw and verify conclusions there needs to be qualitative analysis, to begin to note regularities, patterns, explanations and possible configurations. The data should be held lightly, to maintain openness to interpretation and meaning.

From a design perspective I suggest that there are two key exit points from research into design. In order to maintain the clarity of data manipulation, I suggest that each piece of research is written up as an individual case study. For additional clarity, I suggest a reflection should be undertaken at key stages and following each study, to ensure that the difference between data and creation is maintained.

6.3. Intellectual Property and Valuing Contribution

This section considers the ownership of the data created in the design process. According to Kapila and Lyon (2006, p.3):

'There is a debate over the intellectual property rights of the knowledge collected i.e. who owns, and has right to the information. The ownership of information is an important issue and work must be used to help the village group or wider and not just for scientists to update records and increase their knowledge.'

I suggest that the data, and the design creation from the data, is owned by both the participants and the researcher. This creates a dilemma concerned with the value of the input from the research participant.

Kapila and Lyon (2006, p.3) suggest:

'It is strongly recommended that research teams do not reward individuals for information by payment or material contributions. This is alien to the principles of participation and can only re-enforce the feeling of us and them and might embarrass or insult.'

I suggest that the participants within this study are voluntary, but recognise that there may be other returns on their input. These may include; inclusion in an experience which they may not be able to access outside the scope of the research, an adaptation which may improve their access to paddlesport, a greater understanding of paddlesport.

6.4. Techniques

6.4.1. Utilising Techniques to Build Understanding and Purpose

This section outlines techniques for data collection and enquiry. Whilst each technique could be considered independently I propose that in order to gather the ‘truest, most balanced’ view of the phenomena each of the techniques will be utilised. It is proposed that the application of the techniques will add depth and breadth to the researcher’s understanding of the phenomena. To build depth it is proposed that data from reflections will inform the identification of themes for semi structured interviews, and then questionnaires. This convergent thinking will be balanced by utilising techniques which may reveal more divergent themes such as participant observation and group based learning or reviewing. It is proposed that reflection will be used as a constant theme throughout the research to allow scope for the more creative approaches which are perhaps more natural to design.

The techniques can also be seen in the context of the concepts presented in Chapter 5, specifically Section 5.6, which introduces the concept of managing groups in the field and Section 5.6.3 which introduces the concept of managing learning for individuals and groups. I see this as the start point for the understanding of Greenaways (1993) approach outlined in Section 6.4.5. From a design perspective each of the techniques has been chosen specifically to inform a formal creative design process in Study 9. The techniques are mapped to design methodologies or processes in

Table 34 Mapping Research Studies to The 7 level design process, BS7000-6 British Standards Institution (2005, p.44) Section 6.5.1, of this chapter. Together the techniques bridge the gap between research, design and fieldwork paradigms.

6.4.2. Semi Structured Interviews

Fontana and Frey (2005, p.702) suggest the following six points for introductions to interviews; 1) Never get involved in long explanations of the study; use the standard explanation provided by the supervisor, 2) Never deviate from the study induction, sequence of questions, or question wording, 3) Never let another person interrupt the interview; do not let another person answer for the respondent or offer his or her opinion on the question, 4) Never suggest an answer or agree or disagree with an answer. Do not give the respondent any idea of your personal views on the topic of the question or survey, 5) Never interpret the meaning of a question; just repeat the question and give instructions or clarifications that are provided in training or by the supervisor, 6) Never improvise such as adding answer categories or making wording changes.

Fontana and Frey (2005) suggest that more modern approaches to interviewing are known as confessional styles, which require reflexivity on the part of the researcher. Fontana and Frey (2005, p.713-714) suggest;

> *'But anyone who has engaged in fieldwork knows better. No matter how organised the researcher may be, he or she becomes slowly buried in an increasing mountain of field notes, transcripts, newspaper clippings, and audiotapes. Traditionally, readers were presented with the researcher's interpretation of the data, cleaned and streamlined and collapsed into rational non-contradictory account. More recently, sociologists have come to grips with the reflexive, problematic, and sometimes*

contradictory nature of data with the tremendous, if unspoken, influence of the researcher as author.'

When considering the ethics of interviews, Fontana and Frey (2005, p.715) suggest three key considerations;

'1. Informed consent – receiving consent by the respondent after having carefully and truthfully informed him or her about the research

2. The right of privacy - protecting the data of the respondent

3. Protection from harm (physical, emotional, or any other kind).'

Skinner (2003) suggests a practical framework to increase the validity of data gathered and reduce interviewer bias during structured and unstructured interviews. From this, I propose the following pragmatic considerations for semi-structured interviews in this research; 1) Standardise questions or subject areas across respondents to reduce interviewer bias, 2) Present the interview in a conversational style, utilising open-ended questions, 3) Keep questions short, 4) Remember the purpose of the research, 5) Avoid biased words or terms, 6) Avoid leading questions, 7) Avoid using questions that ask for highly detailed information, or that are potentially embarrassing, unless absolutely necessary.

With regard to point 7 above, I suggest that this may pose a problem when asking questions concerned with human functioning. I therefore propose to describe the purpose for detailed questions and will ask permission of the respondents. I understand that this is contrary to the thoughts of Fontana and Frey (2005), but feel that it is sympathetic to the confessional style of interviewing which they suggest is emerging.

6.4.3. Observation

Observation is primarily concerned with collecting data and approaches the community from 'inside', to generate practical and theoretical truths. Bogdewick (1999) suggests that gaining access to a community by spending prolonged periods of time observing has four benefits; 1) Increased time in the field reduces the likelihood that the participants' behaviour is changed by your observation, 2) Differences between real and verbal behaviour become apparent, 3) Questions are able to be formed in the language of the participants, 4) The context and meaning of the data or phenomenon become apparent.

He goes on to suggest that the researcher must establish rapport, be unobtrusive, be honest, be unassuming, be reflexive and be self revealing. He outlines a number of categories, or headings, for observation. These are; who is present, what is happening, when does the activity occur, why is it happening, how is it organised.

Bogdewick (1999) suggests that recording can be undertaken as jottings, logs or field diaries, extended field notes, or permanent notes. He recognises that jottings may be the only tool available and suggests that these should be written up in the field as a field diary, which can then be expanded upon into extended field or permanent notes.

When considering note-taking, he suggests five priorities. These are; 1) Record the notes as soon as possible after observation, 2) Do not discuss your observation with anyone until you have recorded it, 3) Find a private place, 4) Plan sufficient time for recording, 5) Do not edit as you write or dictate.

Finally, Bogdewick (1999, p.69) suggests that the art of participant observation is;

'Seeing what is before him rather than what he is accustomed to seeing. This does not require genius; it requires practise […] In participant observation, who you are and what you see cannot be separated, only understood.'

6.4.4. Questionnaires

I propose to use questionnaires to ask specific questions, to gain both quantitative and qualitative data.

When designing the questionnaires, both in terms of the graphic design and layout, I propose to make them accessible by utilising clear print and, where possible, according to the guidelines set by the Royal National Institute of Blind People (RNIB 2006).

When structuring the questions to be used in questionnaires, I propose to use the framework proposed by Skinner (2003) in section 6.4, to help improve the validity of data. The questionnaires will be structured to first ask for quantitative data, before then asking for further qualitative data to back the quantitative data.

According to Kirk and Miller (1986), on its own quantitative research provides 'empty data'. They go on to suggest that qualitative methods give significance to meanings, rather than simply being reliant on the counting of numbers for the drawing of conclusions. Qualitative methods provide interpretive information. The questionnaires will therefore ask for a qualitative appraisal of a particular subject from the respondent and will be followed by a more probing, open-ended question, such as, "Please explain".

6.4.5. Greenaway Reviewing

Greenaway (1993) promotes the use of reviewing to add value to experiences in outdoor settings. He presents a four-stage process, which is summarised as; 1) Experience (WHAT) - playback or re-live what has happened, 2) Express (FEELINGS) – what was it like; what are the themes or feelings, 3) Examine (DETAIL) – increase the depth and expand upon the detail of what happened, 4) Explore (PLANS/DESIGN) – summarise findings to set new targets.

Greenaway (1993, p.15) suggests the following definition of reviewing;

> *'Reviewing is an activity that is used to encourage people to reflect, describe, analyse and communicate what they have recently experienced. It is any process in which the purpose or effect is to enhance the value of a recent experience. It can involve focussing attention on the past, present or future. Alternative terms for 'reviewing' are: 'processing', debriefing' and 'reflection'.'*

I see that reviewing has a direct fit with the nature of this learning based research. Greenaway (1993) suggests that reviewing improves the learning climate by improving; belonging, acceptance, care and friendship, praise and recognition, responsibility, self-respect, creativity, achievement, and development of new experiences. Finally, he suggests that reviewing offers four additional benefits to group-based learning, which are of direct relevance to this study, as shown in

Table 33.

I see reviewing as a framework to clarify both the researcher's and participants' viewpoints, and intend to utilise this framework in an ad hoc manner to aid data clarification.

Table 33 Benefits of Reviewing to this Research, based on Greenaway (1993)

Reviewing benefits to group learning	**Benefits to this research**
Encourage participation	Study participants may well experience a lack of opportunity in the proposed research area
Demonstrate what has already been achieved	Provide a clear foundation for gathering more data, separating opinion from experience
Assess learning needs	Provide a link between the learning of the participants' involved in the study and the equipment requirements, as required to provide clear guidance to both coach and designer
Discover previously unknown capabilities	Reveal the true nature of the performance and help to separate performance enhancement into technological and coaching requirements, ie identify where performance finishes and equipment starts

6.5. Case study Format

Case studies are described by Miles and Huberman (1994) as an approach not a technique, they are used when there are low numbers of respondents. Given that this study includes a very specialist dimension of a minority community, I have decided to take this approach. Utilising a case study approach fits well with issues concerned with observation as described in section 6.4.3 of this chapter.

6.5.1. Inclusive Design Methodology

In this section I outline operational standards in inclusive design management and illustrate how this research maps with current thinking in this area. From a philosophical perspective, I suggest that design can be considered in terms of research. Research is the direct observation of experience, while design can be considered in a similar framework, creative design as a confession of the researcher's understanding of the data. Additionally, I suggest that design requires interpretation on the part of the research-led designer, who must therefore take an interpretivist standpoint. I also suggest that design in this context should be seen as learning, as success in design terms requires the designer/researcher to truly understand the data which is influencing their creative process. Research led design can therefore be considered as confessional, interpretivist learning.

From a practical perspective, however, I suggest that design and research have a natural fit, and consider design sketches as a natural 'jottings' to a field-based study. I propose that the design activity in this study is considered separately, to maintain clarity between objective observation and creative interpretation.

Table 34 illustrates the link between the proposed research studies and the design phase of the research. It places this research in the 7 level design process (BS7000-6, British Standards Institution 2005, p.44).

Table 34 Mapping Research Studies to The 7 level design process, BS7000-6 British Standards Institution (2005, p.44)

Level (No.)	**Approach**	**Studies as described in Table 35 Overleaf**
1	Identifying user wants and aspirations. Defining then verifying the complete problem, including social acceptability requirements.	1,2,3a,3b
2	Determining user needs. Specifying the functionality to be provided then verifying the functional specification.	5,6
3	Facilitating user perceptions. Introducing appropriate output/feedback mechanisms, then verifying that users can "perceive" (see, hear, etc.) the output from the product.	7
4:	Ensuring users understand how to use the product. Structuring interactions that match user expectations of how the product should behave, then verifying that users understand the product's behaviour.	7
5	Ensuring users can interact physically with the product. Developing quality of control and user input, then verifying that the users can control the product without undue physical discomfort.	7,8,9
6	Verifying that the product does what is intended. Evaluating the total product's functionality, usability and accessibility, then validating its practical acceptability.	7,8,9
7	Confirming that users are happy with the product. Evaluating match with user requirements then validating social acceptability.	7,8,9

6.6. Research Plan - Map of Proposed Studies and Methods

This section provides an outline of the proposed research. Each study is written in its entirety. The aims, objectives, results and conclusions for each study can be seen in the appendices. Key results and a summary of the each study is given in Chapter seven Results. The research plan is summarised in Table 35.

Themes generated in studies 1 and 2 will inform the creation of the semi-structured interviews in studies 3a and 3b.

Study 4 will utilise themes gathered from studies 1, 2, 3a and 3b and capture themes from the participants.

Study 5 as an observation creates the opportunity to explore the theme of coaching, and will be structured by the participants.

Study 6 will reveal data with regard to coaching and organisation of inclusive groups and will be led by the participants.

Study 7 will allow the researcher to apply understanding gained from studies 1, 2, 3a, 3b ,4, 5,and 6 to participate in a more active manner, acting on the phenomena but gathering data through participant observation and reflection, whilst being immersed in the phenomena.

Study 8 will utilise questionnaires developed from experience gained in studies 1, 2, 3a, 3b, 4, 5, 6, and 7 to gather base line data from the participants, feedback concerning experience will be gained through participant observation.

Study 9 will utilise a design process to create an artefact for test.

Study 10 will utilise the same approaches as study 8 and will validate the artefact and the research tools.

Study No	Name	Semi Structured Interview	Questionnaire	Participant Observation	Group Based Reviewing	Greenaway 4E Reflection	Location
1	Reflections on past expeditions	N	N	N	N	Y	Desk
2	Reflections on past design work	N	N	N	N	Y	Desk
3	Iceland field trial	N	N	Y	Y	Y	Iceland
4a	Semi-structured interviews with lead users to discover user wants	Y	Y	Y	N	Y	Studio
4b	Semi-structured interviews with lead users to discover user perceptions on kayak personal perfomrance	Y	Y	Y	N	Y	Studio
5	Observation of two lead users and a coach	N	N	Y	N	Y	Loch Morlich
6	Skye integrated sea kayaking	N	Y	Y	N	Y	Isle of Skye
7	Canada-Alaska expedition	N	N	Y	N	Y	Canada and USA
8	North Uist 2004	N	Y	Y	N	Y	N Uist,

Study No	Name	Semi Structured Interview	Questionnaire	Participant Observation	Group Based Reviewing	Greenaway 4E Reflection	Location
							Scotland
9	Design	Iterative design process					Studio
10	North Uist 2005	N	Y	Y	N	Y	N Uist,

Table 35 Research Plan

Figure 34 Study Schema provides a diagrammatic explanation for the research process of the study design. Starting from the desk-based research to gain learning leads through to action research for application of the desk-based research to user-centered design. The research is thus able to move from a theoretical framework through interpretation to a participatory framework. The themes from the desk-based-research have been utilised to form the basis of the later elements of the research. The relationships are indicated by the coloured connections shown in Figure 34.

The ten studies completed reveal the successful involvement of spinal cord injured intermediate level sea kayak athletes in the research and development process. They show a development in methodology about how to plan, participate in and review research for the development of postural support equipment and kayak paddlesport opportunities for kayakers with SCI. By the end of the conclusion of the studies, a successful postural support system had been created.

The format of each study affected the success of the involvement, or contribution to the development process, by the athletes with SCI. The format also had to consider how this balanced with the role/needs of the researcher and the aim of the study.

As the studies progressed, the effectiveness and accuracy of the research tools improved, culminating in the creation of a set of field-based data collection frameworks that balance input from the performer, designer, coach and therapy perspectives.

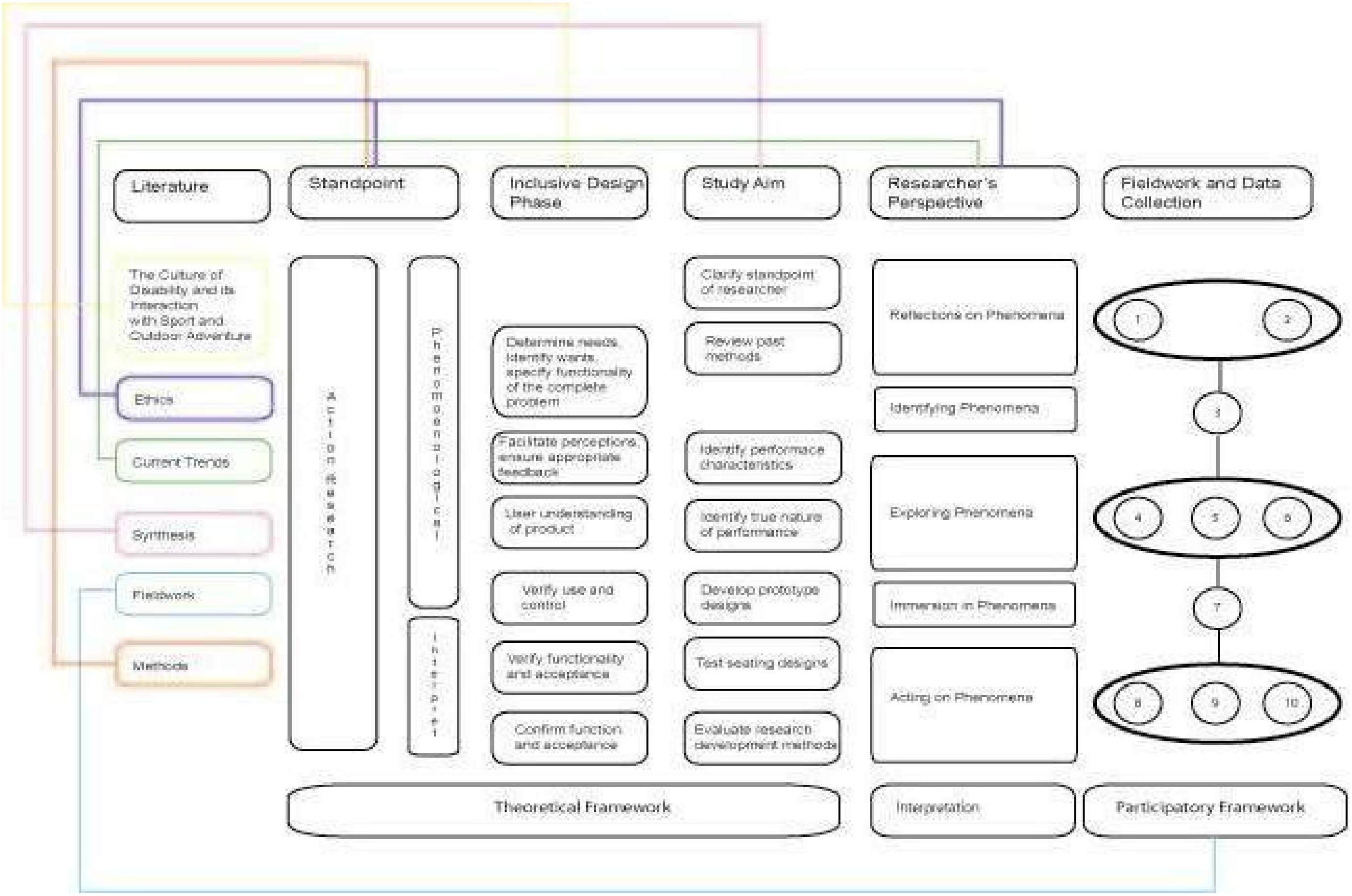


Figure 34 Study Schema

7.

Chapter 7

Conclusion

7.0. Chapter Introduction

This chapter draws the research together. The concluding process is laid out in five distinct sections to enable the reader to see the conclusions in context of the results and literature review. The five sections are as follows; summary of results in Section 7.1, discussion of themes raised in the research in Section 7.2, review of PhD against its hypothesis aim and objectives in Sections 7.3, conclusions in Section 7.4 and future work in Section 7.5. In this chapter I utilise the framework of 'wicked problems' identified by Horst et al (1973), to structure the key themes identified in the research and provide a map for the new knowledge.

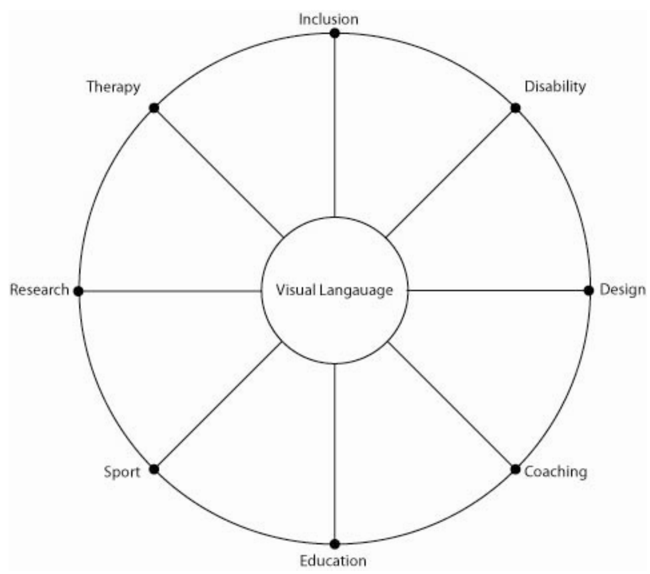


Figure 35 Interdisciplinary connections

The conclusions include twelve new conceptual models that together form a visual language, as defined by Horn (1998). The elements of the visual language presented link research to design, therapy to coaching, disability to sport, and inclusion to education, to form a joined up approach to the creation of opportunities and resources with disabled people with SCI in adventure sport, as shown in Figure 35 Interdisciplinary connections.

7.1. Summary of Results

This section provides a summary of the results from the ten studies and discusses their findings in relation to the literature review. The aim here is to provide the reader with the context to the discussions and conclusions, given the qualitative nature of the data gathered during the research. Each study summary includes an aim, method, results and conclusions.

7.1.1. Study 1 – Personal Reflection on Past Inclusive Expeditions; Coppermine, Israel and Ganges and Selected Professional Design Research Projects in Seating (AQUABAC)

7.1.1.1. Aim

To gather any additional learning from my past inclusive field-based experiences.

7.1.1.2. Method

The study utilised the 'Four E' reflection method presented by Greenaway (1993); experience, express, examine and explore.

7.1.1.3. Results

Study 1 suggested that the process of inclusive expeditions is no different from any expedition or fieldwork project. It highlighted six key themes for the expedition or fieldwork planner. These are the importance of selecting the right individuals within the team, addressing individual participant needs, the importance of planning and preparation, the need to create paperwork for recording the planning, the need to create a positive experience, the need to create an educational experience.

Study 1 revealed the importance of creating a positive person-centred experience for the participants. Undertaking research in this format is challenging because of the dynamic environment and nature of teams. There is a need for tools for the researcher and for the expedition planner so that they can maintain a quality to the person-centred approach.

7.1.1.4. Conclusion

Study 1 provides the framework for the research presented in this thesis, the aim of which was to produce effective postural support equipment for kayakers with SCI. It reflects on aspects of my previous fieldwork that was informed by information gathering and interpretation for the subsequent studies. Some key thematic needs emerged from this study regarding planning, communication, equipment and people.

7.1.2. Study 2 – AQUABAC – A Reflection

7.1.2.1. Aim

To gain learning from research on the AQUABAC postural support undertaken prior to the commencement of my PhD research, to provide more informed methods for the PhD research.

7.1.2.2. Method

The study utilised focus group research and user testing, followed by Greenaway’s (1993) ‘4 E’ method.

7.1.2.3. Results

Study 2 suggested there needs to be a more robust link between research and design. It showed the need to develop research tools that are appropriate to the designer. There is a tension between the real world and research because of the requirements of external stakeholders, be these social, financial or logistical.

7.1.2.4. Conclusion

The research and development was successful and led to a number of design and achievement awards. The strength of the project was in its ability to involve so many users over the length of the iterative process.

The user group did not continue to canoe or kayak beyond the sessions provided during the research. There was an element of sports development missing. The marketing was poor, with none by the charity and that by the university mainly being publicity for the university. More needed to be made of the coaching and design interface and to ensure that there was a way of embedding the use of the new technology into the community.

It was concluded that while the project was very much led by design and external stakeholder requirements following an intuitive process, in future a more in-depth methodological approach would be needed.

7.1.3. Study 3 – Iceland 2001

7.1.3.1. Aim

To understand how to best use a field trial to research people-centred product design.

7.1.3.2. Method

The study used group reviews, participant observations of spinally injured participants, coaches, therapists, facilitators and the researcher, followed by a reflection written using Greenaway's (1993) '4 E' method.

7.1.3.3. Results

Study 3 revealed the need to educate participants and staff about the processes of methods of data creation. All those present had different views of risk and adventure and different motivations, but all had something valuable to say. It became apparent that the researcher’s role is to hear all these voices, including those of the participants, coaches, therapists and designers, and to interpret them for use in the iterative design research process.

Study 3 also highlighted that the technological requirements do not always need to be met by the creation of new equipment, but by the redistribution or application of standard equipment or modification of coaching.

The field-based adaptations that facilitated the rafting experience highlighted the need for basic water safety principles to be adhered to. The rafting experience itself suggested that introducing the concept of inclusion to an adventure provider in a research setting may not lead to either a successful experience for the participants or the designer.

7.1.3.4. Conclusion

Study 3 was my first experience of person-centred field research with a research objective central to its aim. Group reviewing was a good methodology for information gathering in a group setting. It revealed differences in approach between coaches and therapists, interview criteria which combined coaching and therapeutic standpoints, as well as a skew in attitude toward risk and disability, particularly by those with little or no experience of being on water with disabled people. Technical issues were revealed concerning the adaptation of white water rafts to include disabled and non-disabled people, including a checklist for seating and a list of additional standard equipment for use by an inclusive sea kayak coach.

7.1.4. Study 4 – Questionnaires and interviews with disabled sea kayakers: - Aberdeen 2002

To explore practical equipment issues, aspirations, and current understanding and practice with three lead user kayakers with spinal cord injury.

7.1.4.1. Method

Questionnaires and semi-structured interviews were utilised.

7.1.4.2. Results

Study 4 involved questionnaires and interviews with disabled sea kayakers, to explore practical equipment issues, aspirations, and current understanding and practice.

This study may have been limited by its small sample size (n=3), but revealed three distinct findings about organisation, education and design. Inclusive sports equipment design in this setting needs to create immediate design solutions so as not to interfere with the coaching process. The participants lacked knowledge about posture and its impact upon performance and so were limited in their input to the design process. The carbon fibre hoop worked, though there were concerns about the posture of one of the participants. A range of practical design criteria were revealed: a spend maximum of £200, the requirement to work in a range of different craft, the need to work in a range of different sea conditions.

7.1.4.3. Conclusion

Study 4 reveals information about equipment and aspirations of three lead user spinally injured sea kayakers.

All the participants aspired to improve their performance and to be able to participate independently. They wanted equipment that prioritised portability and an increase in kayaking control, including the ability to roll, and were concerned about the balance between security and exit as a result of a capsize. The participants wanted equipment for use in a range of craft for use in sea and river kayaks, at an optimal price of no more than £200.

The participants were found to have little knowledge about posture and its impact upon performance in a kayak, suggesting the need for further education of the participants before they can have further input into the design process.

The study reflection revealed the need to provide participants with immediate design interventions while they are on the water, as lengthy interventions interrupt their kayaking session. This can present a challenge to the researcher, whose main aim is ultimately to create the most robust solutions, with time-frames and participant experience within the design process being secondary. However, participation in meaningful activity helps to calm the participants and they are therefore then able to provide more meaningful data.

There is a need to gain further understanding in a range of different sea states or conditions. This study may also have been limited by the relatively small sample size.

7.1.5. Study 5 – Observation of Top Level Coach – Coaching Sea Kayak on Inland Flat Water

7.1.5.1. Aim

To identify the techniques used by a coach when trying to understand the needs of disabled athletes in a sea kayak.

7.1.5.2. Method

Study 5 was an observation of a kayak coach, to identify the techniques used by a coach when trying to understand the needs of disabled athletes in a sea kayak.

The project utilised notes written at the time of participant observation to inform the researcher and Greenaway's (1993) '4 E' method as a framework for the reflection.

7.1.5.3. Results

This study suggested that it is possible to educate both the performer and the designer at the same time. It also revealed that the difference between an inclusive rather than non-inclusive coach is the planning and organisational commitment.

7.1.5.4. Conclusion

Coached sessions were found to provide direct educational output for both the participant and the designer. There was also a commonality between the coach and the designer, who are both required to understand the task in hand. This suggests that participatory field-based sports equipment design is learning for all stakeholders.

The key difference between an inclusive coach and non-inclusive coach is the level of organisational and planning commitment that they choose, rather than their ability to educate, or coach, their sport. The set-up of the environment, clarity of objective and simplicity of task help to identify potential changes to performance for the performer in a coached session.

This may differ when working with participants who have different functional requirements.

7.1.6. Study 6 – Inclusive 4* Training with Integrate Paddling/BIB, Skye – July 2002

7.1.6.1. Aim

To see if it is possible to run an inclusive sea kayaking event that meets the needs of both disabled and non-disabled people, and to see how a high level coach would cope with a group of disabled and non-disabled kayakers in a formal coaching setting.

7.1.6.2. Method

Potential participants were invited to attend the course. Information was provided about the course, location and costs involved, as well as information about the PhD research study.

Participants and the coach were observed on the course, discussions were had with the coach, and notes and jottings were recorded.

Post-course questionnaires were handed out to the participants.

A reflection was written later, using Greenaway's (1993) '4 E' method.

7.1.6.3. Results

This study showed that it is possible to run an inclusive sea kayaking event that meets the needs of both disabled and non-disabled kayakers. Feedback from the participants suggested that the coach may not have been in his comfort zone and that the researcher was the greatest contributor to the coaching content. This illustrates that even high-level coaches may not understand inclusive practice. The researcher was limited by not being on the water or able to provide immediate equipment design solutions, suggesting that a successful intervention should mix both participation and technical elements.

7.1.6.4. Conclusion

Post course questionnaires showed that it is possible to run an inclusive sea kayaking event that meets the needs of both disabled and non-disabled people. The participants all felt they had benefited from the course and had enjoyed being with their friends. This may well have influenced their answers to the questions about being in an inclusive group.

Observations and discussions revealed that although the coach was able to deliver the necessary technical information, the coach felt out of their comfort zone when working with the disabled members of the group and this affected the overall experience for all.

While non-disabled paddlers have a huge choice when looking to access a course, disabled paddlers do not benefit from this same choice and this may then limit their opportunities for progress.

Not being on the water limited some of the researcher's observations, as did not being directly involved with the coaching and not being able to immediately address equipment needs. This reduced the number of learning and feedback cycles available.

Coaching/leadership is an art, not a science, and so the need is to provide resolution, not solution, when addressing task, team or individual and equipment. This may involve adaptation in a range of different settings, being that the outdoor sea environment is constantly changing.

7.1.7. Study 7 – Canada to Alaska Sea Kayak Expedition 2003

7.1.7.1. Aim

To identify factors which affect the performance of two lead user kayakers with SCI in their flow state in a field expedition setting and to assess the efficacy of two prototype pieces of equipment to drive an iterative design process of seating solutions.

7.1.7.2. Method

Observation and a reflective log using Greenaway's (1993) '4E' method were utilised.

7.1.7.3. Results

This study provided an inspirational framework. It provided access to an outdoor environment for two disabled athletes. It revealed conflict between the daily living needs of the disabled team members and the fatigue or injury of the non-disabled team members as a result of facilitating daily living and care needs over an extended expedition setting. The team may have been too small and may in this instance not have undertaken sufficient training.

Study 7 identified a range of key themes which need to be considered to create an inclusive outdoor experience: information about planning, environment, task, standard and adaptive equipment, and individual performance.

Overall, the field experience provided the researcher with an in-depth understanding of the postural support requirements of intermediate level sea kayakers with SCI. It also identified a range of additional problems that need to be solved to make inclusive sea kayaking sustainable across the range of performance levels.

7.1.7.4. Conclusion

The expedition was ecologically sound, minimizing disturbance to marine and terrestrial wildlife while also supporting local trade. It provided a good opportunity to trial the field toilet on an expedition, which was successful in further reducing the team's impact.

The team did not form smoothly in the UK, with only eight days of training in coastal sea conditions plus pool safety sessions. One non-disabled team member withdrew from the expedition due to injury shortly before departure from the UK. The field team was therefore too small during the expedition to effectively cope with the tasks. In particular, there was a high volume of care support requirements, including carrying/moving and handling. Non-disabled team members became increasingly fatigued and keen to have carry-free days, but this was at the expense of the disabled team members who then had no access or mobility.

One member of the team was elected as photographer, to share images upon return. Similarly I learnt the importance of taking responsibility for personal equipment, keeping it ordered, considered and minimalist. It was also useful to make international contacts, which were generated prior to departure and called upon when situations arose.

The expedition proved extremely useful in providing information about planning, environment, task, standard and adaptive equipment, and individual performance. Due to changes to my intended position in the team and more immediate issues with team members I could only gain directional feedback concerning equipment, rather than the intended conclusive feedback.

The directional feedback showed that the two equipment solutions worked well, although it took time for one participant to attempt to adopt one solution.

7.1.8. Study 8 – North Uist, Outer Hebrides 24th-31st July, 2004

7.1.8.1. Aim

To re-evaluate the efficiency of three postural support solutions for spinally injured sea kayakers, within a coached intermediate environment, based on community rather than expedition participation, in order to inform an iterative design process.

7.1.8.2. Method

Following initial interviews and observations of the participants, questionnaires and observations were utilised to individually tailor the seating solutions. Reflection using Greenaway's (1993) '4 E' method was then utilised to further inform the research.

7.1.8.3. Results

Two key themes were revealed in this study, these being practical design considerations and the need for effective field trial data collection tools. The practical design considerations involved the evaluation of a number of components. The study revealed that the following components were beneficial to kayakers with SCI: footplate, heel pad, knee brace or wedge, seat pad. It also allowed for a number of support options; Butterfly, Hoop, Dynamic. Ease of entry and egress to the kayak are critical to the successful design of any piece of equipment. The study identified the need to look at whether to create an option for attachment of the chosen seating system prior to or post entry to the boat.

It was satisfying to find that the AQUABAC worked well for novices, so that the PhD research could continue by focussing solely on a solution for intermediate level sea kayakers. This was an important finding, as it enabled the iterative process to move forward and maintain its focus. If the AQUABAC had proved not to be a viable solution for novice sea kayakers with SCI, it would have been necessary to broaden or refocus the aim of the design research to facilitate any increase in opportunity for sea kaykers with SCI.

The field trial format was successful because it did not have the challenges created by an expedition, but was of sufficient duration to provide meaningful engagement with the performers. It enabled the researcher to focus on just one element of the development process, this being the equipment design. There were coaches available who were able to focus on the coaching, leaving the researcher able to focus on the application of research and technology in a design process.

7.1.8.4. Conclusion

This was a successful trial that allowed the evaluation of a number of components; footplate, heel pad, knee brace or wedge, seat pad. It also allowed for a number of support options; Butterfly, Hoop, Dynamic. This study was based on community participation and without the extra challenges created by an expedition (as in previous research), succeeded in revealing much more about the equipment.

Once the sea kayaker had gained some confidence with the sea kayaking itself, the equipment proved itself to be efficient in providing postural support. The AQUABAC was a success for the novice sea kayakers, which means that it is possible to focus the design efforts on the development of an intermediate level support, rather than creating a design solution which bridges both participation modes. (Sea kayaking is often seen as an intermediate level sport within kayaking.)

The intermediate kayakers revealed an improvement in their performance. Their design interventions identified components which, when combined, may well create a modular system that would be capable of supporting the needs of a wide range of intermediate sea kayakers with spinal cord injury and complimentary balance needs.

The study revealed that the design solutions which each of the participants utilised have merits. None of the participant feedback was dramatically negative. This suggests that the design solutions could be used as a menu of design modules or features for a synthesised modular design. Getting in and out, adjustment and ease of use during a capsize rescue remain factors which are of high importance to the participants. Consideration should be given to the nature of the fitting. The question remains as to whether the support locates into the boat prior to the participant getting in or is added once the participant is in the kayak.

The reflection revealed that it is possible to create meaningful intermediate sea kayaking opportunities without injury to staff or participants through the use of: good choice of location, planned coaching sessions, understanding of the environment, minor adaptations or additions to standard sea kayaking equipment.

Being able to focus solely on one element of the development cycle proved to be highly successful. This involved both financial and logistical input from a number of organisations, which I recognise is not always possible. It is therefore important in the next study to consider a number of tools to facilitate the designer-coach role efficiently, whilst at the same time evaluating the emerging modular seating system.

7.1.9. Study 9 - Design

7.1.9.1. Aim

To utilise a creative design process that builds on research and learning from field-based and desk-based studies to create a biomechanically safe, highly portable, modular device which facilitates safe and efficient sea kayak performance for intermediate sea kayers with paraplegia resulting from SCI.

7.1.9.2. Method

The study drew upon the desk-based literature review and field-based involvement.

7.1.9.3. Results

The key finding from this study was the innovation of a modular piece of equipment, this being the active back support. Study 9 provided the most satisfying part of the research journey, as the researcher was able to pull together all the learning to date to create a new piece of equipment. Not only did the solution suggest that it may successfully provide postural support, but it was light and easy to carry, even by a wheelchair user. It could be replicated at relatively low cost for future testing and user-based research, and was manufactured for test in Study 10 (see Section 7.10).

7.1.9.4. Conclusion

The study was successful and concluded with the development of a practical solution that is able to be replicated at relatively low cost in order for further testing or user-based research.

The study created a piece of equipment that is sympathetic to the human body whilst kayaking. It also created equipment that is light and easy to carry, including by a wheelchair user. It has the ability to be tailored to the needs of different participants, dependent on the level of support required.

The active back support is now at a stage where it facilitates safe and efficient sea kayak performance for intermediate level sea kayakers with SCI.

7.1.10. Study 10 – North Uist Outer Hebrides

7.1.10.1. Aim

To evaluate the practical and methodological product of the previous studies and research, in particular Study 9.

7.1.10.2. Method

Interviews, observations, a product review form and reflections using Greenaway's (1993) '4 E' method were utilised. Field-based data collection tools, in the form of questionnaires, were utilised to assess the seating concepts. Participant observation was utilised to add depth to the researcher's understanding of the validity of the seating concepts. Reflection was used to provide an assessment of the field-based data collection tools.

7.1.10.3. Results

Study 10 evaluated the practical and methodological product of the previous studies and research. The equipment created in Study 9 provided the opportunity for the use of a new process in this research, centred around review rather than development. The performers tested the product and succeeded in improving their level of performance.

This study provided the opportunity to design a structured review tool for use by others in the future. The pro-formas used worked well. Future principles for pro-forma design should ensure that they can be independently completed, in sections, and as close to the experience as possible. They need to include information about measurements, weather and environmental information, and time of peak experience for the performer.

The logistical challenges experienced by the researcher of environment, fitting and organizing remain as potential distractions to the research. One performer's testing of the equipment was limited by her technique, showing the value of expeditions which provide a longer journey, allowing time for technique to be adapted. This also demonstrates that there is a remaining tension between the designer and other stakeholders involved in the design and testing process that must be balanced to create the pre-conditions for successful creation of opportunities and resources.

7.1.10.4. Conclusion

The equipment was a success. It proved relatively easy to fit to two individuals with varying levels of SCI, both of who reported an improvement in performance as a result of using the design.

The pro-formas worked well, and provided a good structure for discussion and feedback.

In practice it is challenging to maintain a harmonious programme of events while undertaking the fitting, helping to organise and also removing the environmental barriers to participation. The pro-formas therefore need to be designed in such a way that they do not require the involvement of the researcher at the initial time of completion. This requires the pro-formas to be written in sections that can be completed quickly, easily and independently, as close to the experience as possible.

In previous studies, information needed to be gained from participants to start the design process. In this study the research had moved to a new stage: now I have a product, how do I review it? This required the change from relatively informal processes, to using a more structured tool that others could replicate should they choose.

Additional elements to include in future pro-formas would be: space for measurements, weather conditions and more environmental information, when was the peak experience for the performer.

One participant noted that testing of the equipment was limited by their ability to adapt technique to meet the new sitting posture. This goes some way to explaining the value of expeditions, where participants have such long journeys to do that they have the benefit of time to adapt their technique, creating a more effective test.

7.2. Discussions

The following section discusses the findings of the research and outlines the new knowledge to the field of outdoor studies, disability and inclusive sports equipment design. The results gained from the ten studies suggest that there are a range of technical, organisational and attitude barriers to the creation of inclusive adventure sports opportunities that require a unified approach to their resolution.

Inclusive opportunities require the application of technology, coach education and the removal of social barriers to access. The studies found that the development of opportunities with disabled people in adventure sport benefits from the involvement of a number of practitioners who together can utilise an interdisciplinary approach to reduce the barriers and create opportunities with the performer. Most important is the need to explore why the application of a joined up interdisciplinary approach can be challenging to both individuals, practitioners and organisations.

I suggest that the creation of inclusive sports opportunities with individuals and communities of people with disabilities can be seen as a 'social mess', as defined by Horst et al (1973). Horst et al (1973) identified that social planning problems, or 'wicked problems', often do not fit with traditional linear approaches to problem solving, where the problem can be clearly defined and a solution found.

According to Horn (1998), 'social messes' are those situations about which different stakeholders have very different perceptions and values concerning their causes and suitable solutions. They are those situations that elicit different viewpoints from the first time they are experienced. Horn (1998) describes 'wicked problems' as those problems that are challenging or even impossible to solve due to incomplete, contradictory, or changing factors that are often difficult to recognise. While attempting to solve one aspect of a 'wicked problem' other problems may be revealed or created. Horn (1998) also introduces the concept that 'sticky information' relates to how well different information naturally sticks together. Professionals from the same discipline tend to speak the same language, while those from different disciplines may start from different viewpoints and find it difficult to get beyond the basics of communication with others outside their discipline.

The research reveals that the barriers to the universal application of resources to creating inclusive opportunities are concerned with the way in which different groups perceive each other. The literature review identified the concept of 'social distance' (Mastro et al 1996, see Section 1.3.1). The field studies suggested that some senior practitioners can be thrown into a state of inaction by the prospect of having to include both disabled and non-disabled people in their activities. This inaction, combined with the need to utilise approaches from a range of disciplines, suggests that the move towards inclusion can be considered as a ‘social mess’ (Horn 1998) that leads to the creation of a ‘wicked problem’ (Horn 1998). The information flow around the development cycle can be ‘sticky’ (Horn 1998), as practitioners from differing disciplines and participants from different communities create it.

For the action based design researcher acting in a solo capacity, or on limited resources, the research revealed frameworks which can be used for capturing data in order to act more efficiently to create, inspire and inform others of the new resources and opportunities.

7.2.1. System and Process Approach to Inclusive Design of Adventure Sports Opportunities

7.2.1.1. System Approach

Morgan (1998) suggests that it is possible to see organisations in a number of formats and the way in which the organisation is viewed affects the way in which a problem is approached. He views organisations under three headings; people, power and practicalities, as seen in Figure 36.

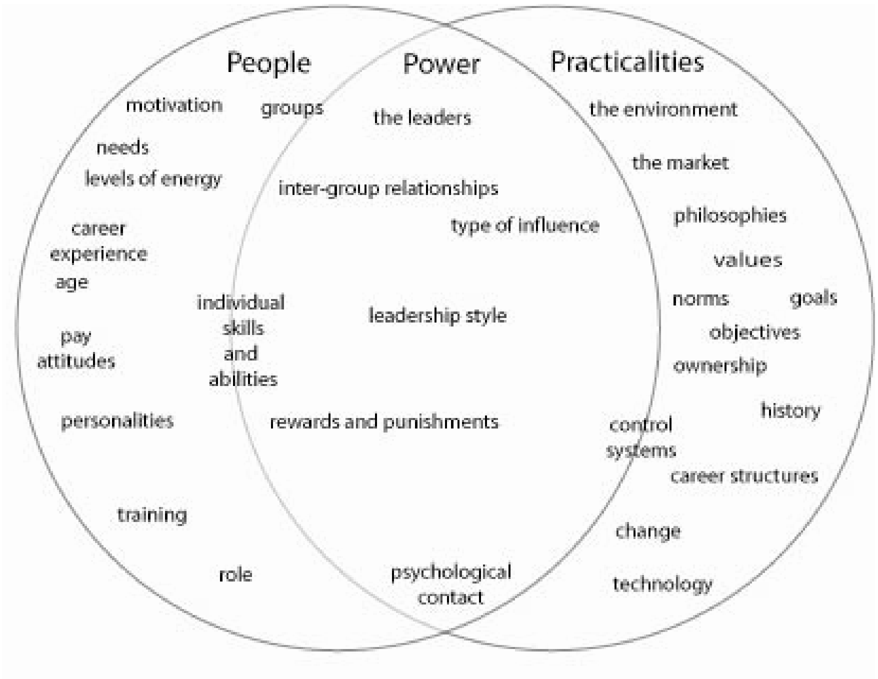


Figure 36 Morgan (1998) People Power Practicalities

Morgan's (1998) model suggests that not all people have the same characteristics and so are able to wield varying levels of power, thus playing a range of roles within organisational tasks and activities. I take the view that in the context of inclusive outdoor equipment design the team can be seen as an organisation in flux and transformation. Individuals within this organisational structure are able to wield varying levels of power.

Keates and Clarkson (2004) take a system-based approach to inclusive design, suggesting that the successful implementation of inclusive design requires the successful transfer of knowledge between people involved in the inclusive design process.

Combining the models of Morgan (1998) and Keates and Clarkson (2004), I take the view that all the stakeholders within the sports equipment design process need to be involved and communicate together, but may not gain an equal level of power throughout the process. I suggest that a more successful process or methodology is a more equitable process or methodology, so as not to create a bias towards the perspectives of any one of the stakeholders.

In order to make the sports equipment design process more efficient and equitable I propose that the process needs to be viewed in a broader context than that presented by Keates and Clarkson (2004), to encompass the social context of the design process.

7.2.1.2. Process Approach to the Development of Inclusive Adventure or the Resolution of a 'Wicked Problem' as defined by Horn (1998)

The problem of creating opportunities with disabled people in adventure sport exists within a 'social mess', as defined by Horn (1998). My research suggests that the creation of adventure sports opportunities is a 'wicked problem', (Horn 1998), which is embedded within a 'social mess', (Horn 1998) and that the stakeholders acting on the problem from within the 'social mess' are confronted with 'sticky information' (Horn 1998).

7.2.1.3. Why is inclusive sports equipment design a 'wicked problem'? A definition and justification

Various schemas for 'wicked problems' exist, including those by the Australian Public Service Commission (2007), Ritchey (2007) and Horn (1998). This section outlines a justification for classifying the development of adventure sports equipment and resources for people with SCI as a 'wicked problem'. 'Wicked problems' by nature are difficult to clearly define. I utilise the Australian Public Service Commission (2007) characteristics as a basis for defining 'wicked problems' in the context of inclusive sports development, with characteristics 9 and 10 from those outlined below taken from Ritchey (2007), in order to form a schema that I feel is applicable to this context.

7.2.1.3.1. Wicked problems have many interdependencies and are often multi-causal.

The true nature of the problem does not always become clear until part of the way into solving it. The design research process is like a journey, as with each iteration from the designer, the athlete's skill level increases and new techniques have to be included in the performance. The sports equipment is only one factor in the performance mix of the athlete. It is possible to start solving the problem at different intervention points, with the core of coaching, equipment, or planning. It is also possible to start with peripheral requirements linked to the individual, their daily life and personal circumstances. This was demonstrated in Study 3, which revealed there was no concept of what was meant by inclusive coaching and that attitudes to risk varied. Study 4 revealed that the participants or clients did not have a clear view of what they wanted from the design research process.

7.2.1.3.2. Attempts to address wicked problems often lead to unforeseen consequences.

Research, by nature, breaks new ground and therefore it is difficult to imagine what the consequences might be. With this research there was no precedent upon which to base the concept of participation in the outdoors for disabled people. Because non-disabled people consider themselves to be different from disabled people, it can be difficult for the non-disabled community to imagine a disabled person participating in what may be deemed adventurous. This is underwritten by Mastro et al (1996), who presented the concept of 'social distance'.

Studies 3, 5 and 7, which were the more longitudinal studies, revealed many consequences that were unknown at the start. Examples of this include: it was unknown at the start that a field toilet was required, that the group dynamics were so important, that the balance of disabled to non-disabled people could be so influential to the success of the expedition as a whole. An expedition is by nature a task with consequences difficult to imagine.

7.2.1.3.3. Wicked problems are often not stable.

By nature, adventure is uncertain. The outdoor environment is dynamic, so constantly changing. In addition, feedback from those involved in the process may be ambiguous. Critical users (Keates and Clarkson 2004), who provide the illuminating or indicative data in the design research process, may not always have the knowledge or skill to provide accurate feedback. Lead users (Keates and Clarkson 2004), may often be driven by their own needs to such an extent that they may make the project unstable. Coaches may not be suitably trained or have suitable experience to provide valuable feedback and many stakeholders are unclear about what they would like to achieve in this new area.

Studies 3, 5 and 7, being expeditions, involved considerable uncertainty and ambiguity. All the studies could be classed as unstable as they were undertaken in unstable, or dynamic, environments.

7.2.1.3.4. Wicked problems usually have no clear solution.

Designers, coaches and athletes differ in the way they participate in the process and in their view of the problem. There is not one correct view of an inclusive sports equipment design solution. Designers frequently design for themselves and may tend to focus on the technical aspects of the problem. Coaches may consider the educational focus to the problem. Athletes may solely be concerned with their performance and may be less interested in both the technical and educational processes. Study 3 identified that therapeutic, coaching and design perspectives may provide contradictory solutions.

There are barriers to participation for disabled people in society, as presented by Finkelstein and French (1993), which go way beyond inclusive sports equipment. Even if perfect equipment were to become available, a range of other barriers identified in the literature review would still prevent some from participating. There are core issues that create barriers to participation, including coaching, equipment, choice of performance environment and planning. There are also peripheral barriers that must be overcome, including access to the environment, and individual, group or societal attitudes to risk. The peripheral and core barriers can interrelate and interfere with each other, creating a complex connection between themselves.

All the studies revealed that the barriers to participation that surround participation in sea kayaking for intermediate athletes with SCI are complex and interrelated. This was especially highlighted in Study 7, during the Canada-Alaska sea kayak expedition, where team, task, individual, environmental and logistical factors could not be addressed independently.

7.2.1.3.5. Wicked problems are socially complex.

Current views of what is acceptable in terms of risk for disabled individuals has a bearing on the level of investment available, not only financial investment, but also time and goodwill. I suggest that this is applicable to not only those acting upon disabled people, but also to the disabled people themselves. This was revealed in the literature review, with the recognition of primary, secondary and tertiary risk takers (Ogilvie 2005). Study 7 revealed the nature of different risk takers, when AD demonstrated a disregard for personal safety and the welfare of the team as a result of the aggressive development of a pressure sore.

Multi-disciplinary team approaches mean that those outside the community often drive solutions. The community of disabled people that is being acted upon by the team may not have the same values or ideologies as those that make up the team, nor may everyone within the team have the same values and ideologies. This can lead to conflicts, as revealed in Study 7, when AD's injury caused AD to be excluded from the team and the team leader to be split between two groups. This led to a team breakdown and socially complex situation in the field.

Lead users (Keates and Clarkson 2004), desire equipment that is for them rather than for a larger group of disabled people. Critical users (Keates and Clarkson 2004) may not be at an appropriate level of performance at the sport to reveal the limitations of the equipment, even though they may be more interested in developing equipment that is suited to a wider group. As such, even within the community of disabled people that the research seeks to serve there may be conflicts or differences in priorities. This was an underlying theme in all the studies, and led to tension between the researcher and the participants, due to the participants not fully embracing the research process.

7.2.1.3.6. Wicked problems hardly ever sit conveniently within the responsibility of any one organisation.

The development of resources for inclusive adventure sport with SCI participants can be seen as the responsibility of the individual, their community, the sporting national governing body, the disability sporting national governing body, the opportunity provider or the equipment manufacturer. In fact, the desk-based research revealed there are relatively few initiatives that provide resources compared to opportunities.

The policy life cycle (Hylton and Totten 2001) suggested that development is driven by policy and is therefore cyclical rather than constant. Thomas (2000) identified the stakeholders within disability sport and the political infrastructure. Together these suggest that resourcing adventure sports opportunities for disabled people is not a priority, not undertaken by one organisation, and is under resourced.

7.2.1.3.7. Wicked problems involve changing behaviour.

The wider disabled community does not necessarily believe that it can be involved in outdoor activities. Many have no vision of what they want, making it challenging to promote new opportunities. Professionals within the wider non-disabled community have concerns about the appropriateness of adventure and risk involving disabled people. This was evidenced in Study 4, when the coach was ineffective as a result of reticence over working with disabled people in the professional setting. In Study 7, the non-disabled participants were unable to accept that a disabled participant could sacrifice their physical condition to maintain their involvement in the task.

7.2.1.3.8. Some wicked problems are characterised by chronic policy failure.

Within the multidisciplinary team there are different stakeholders with different objectives, often funding related. These can be distinct and conflict with the objectives of the designer and the needs of the community. Within the literature review, inclusive outdoor sport is shown to be poorly resourced, a low priority and dependent on funding cycles, as already mentioned above.

Sports equipment designed specifically for use by disabled people tends to have low quantities of production and therefore high costs of production. This is not economically viable and for some leads to a question about social viability. Is it appropriate for limited financial resources to be spent such that disabled people are enabled to take risks?

Despite contact with national governing bodies of sport, the research has not gained the level of support that might have been expected at the outset. This was also highlighted in the literature review, which revealed that resources for research development in this field will always be sporadic, sparse and driven by political factors.

7.2.1.3.9. The planner has no right to be wrong (planners are liable for the consequences of the actions they generate).

During the process of the research, the researcher has had to be an activist, taking courses in coaching, off-site safety management, first aid and rescue medicine, moving and handling. The researcher has also been directly involved with data collection in the field context. It is only by undertaking up-skilling in allied areas that the researcher has been able to view or experience the true nature of the problem, and has been exposed directly to a greater range of perspectives for solving the problem.

In the action research setting, despite acting ethically and safely, the implications of potentially not meeting the expectations of all stakeholders can affect emotional safety. The participants within the research were unwilling to accept that when the equipment does not fully succeed according to their expectation, this is simply part of the research and learning process, but is a failure on the part of the researcher. There was no opportunity for the researcher to learn by his mistakes, there was only the opportunity for him to learn. By setting up each research intervention as a joint learning opportunity for all, discrepancies in expectations can be mitigated. As such, each study within this research was set up with consequences of mistakes in mind.

7.2.1.3.10. Every solution to a wicked problem is a "one-shot operation"; because there is no opportunity to learn by trial-and-error, every attempt counts significantly.

Creating a resource utilising a user-centred approach within a small community can lead to the results being shared with that community within a very short space of time and before the researcher has had an opportunity to formalise the learning. The community may create its own pace for the research, causing the research to be driven by the community and not by the researcher, unless the researcher accepts the additional responsibility of managing the community's expectations.

I see this list as a startpoint for understanding 'wicked problems' in the context of this research. The following section provides tools and solutions to aid the researcher in resolving the 'wicked problem', as defined in this section.

7.2.2. Solutions to the 'Wicked Problem' of Inclusive Adventure

Horst et al (1973) suggest that 'wicked problems' cannot be tackled by the traditional approach of defining the problem, analysing it and then solving it in sequential steps. I suggest that solutions to the 'wicked problem' (as presented in Section 8.2.1.3) of inclusive adventure can be divided up into three broad levels; macro, micro, and planning or understanding where you are in the process. I consider macro to relate to the big picture of where the research exists within society and micro to relate to the detail linked to the actual product design research. Planning then relates to what you are doing, whether you are acting at the macro or micro level. Design is often as much about logistics as it is about research or innovation. This research has revealed that it is important to understand the process, so as not to waste limited resources early in the design process that cannot be utilised later on.

For inclusive sports equipment design to be efficient and effective, I suggest four principles, given in Section 7.2.3. Twelve tools are then outlined in Section 7.2.4, which can be used in a number of ways to improve efficiency and effectiveness. Each tool can be utilised to best effect within one or more of the three broad levels mentioned above within the resource development process.

I suggest that together the tools facilitate a 'Positive, Functional, Practice Led Approach' to the creation of opportunities and resources with disabled adventurers.

7.2.3. Principles Of Inclusive Adventure Sports Equipment Design

Horn (1998) introduces the concept of visual language, and states that using models and diagram's supports the resolution of 'wicked problems' and reduces the 'social mess', by aiding communication and so reducing the 'stickiness' of the information. I suggest that in the context of inclusive sports equipment development, visual language should be used to:

- Understand key players and/or relationships between these players or stakeholders
- Create a map for interdisciplinary working
- Assist in the efficient application of limited resources
- Co-ordinate and capture outputs from participant, designer researcher, coach and therapist.

7.2.4. Tools

I propose the visual language should aid a range of conceptual models, or tools, to help define the inclusive sports equipment design process. In order to achieve this I suggest the following twelve visual components shown in Table 36 Application of Visual Language Tools. The tools are also described in detail in Section 8.4.1.

Table 36 Application of Visual Language Tools

	Tool	**Principle**	**Level (Macro, Micro, Plan)**
1	What is stopping people: Fear, Fear and Fear model	1, 2, 3	Macro/Micro/Plan
2	Bottom up practice-led approach	2	Macro/Plan
3	Model of inclusive adventure	2	Macro/Micro/Plan
4	Utilising inclusive expeditions and field trials in research and development	4, 3, 2, 1	Macro/Plan
5	Engagement with people: VOICE tool	4, 3, 1	Micro/Plan
6	Positive person-centred functional model	1	Micro/Plan
7	Model of posture	1	Micro/Plan
8	Field assessment and recording tools: Readiness to exercise proforma Anthropometric recording tool Field-based questionnaire	4	Micro
9	Equipment performance relationship	4, 3, 2, 1	Micro/Macro

	Tool	Principle	Level (Macro, Micro, Plan)
	tool		
10	Tracking the research process: Keeping your eye on the ball	4, 3, 2, 1	Micro/Macro/Plan
11	Developing inclusive sports opportunities	4, 3, 2, 1	Macro/Plan
12	Inspiring change, involvement and adoption: WOW-HOW-NOW	4, 3, 2, 1	Macro/Plan

7.2.4.1. Visual Tools in Detail

This section takes each one of the twelve proposed visual tools and describes them in detail.

7.2.4.1.1. What is stopping people: Fear, Fear and Fear model

The aim of this tool, shown in Figure 37, is to reduce the organisational inertia that I suggest can be summarised as Fear, Fear and Fear. By providing this model as part of an introduction or evaluation it is possible to get people started, talking and communicating together. Fear, Fear and Fear is explained as;

Fear of not doing something;

Some are so fearful of the legislative imperative, including the DDA (1995), Special Educational Needs and Disability (2001), Adventure Activities Regulations (2004), that they realise they must do something. They then do just the minimum to suit the legislative imperative rather than what suits the individual, and in doing so alter the unique nature of outdoor adventure.

Fear of not knowing what to do;

Some claim ignorance. Lack of knowledge and understanding about disability means they do everything to keep disabled people away.

Fear of getting it wrong;

Lack of social closeness or perception of difference (Mastro et al 1996) creates the impression that whatever action is taken will be the wrong action. Therefore it is safest to take no action at all.

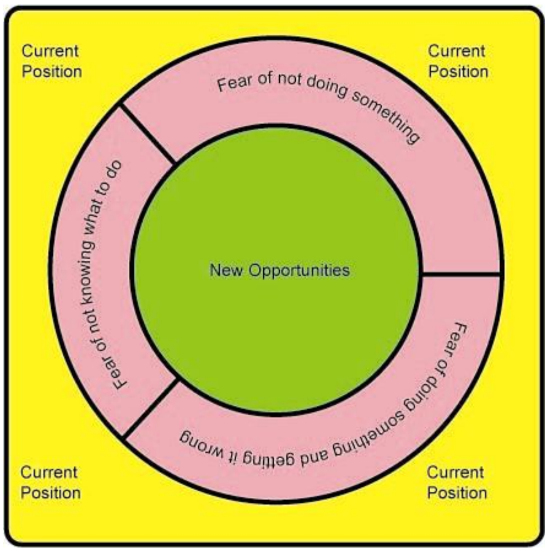


Figure 37 Fear, Fear and Fear

7.2.4.1.2.   Bottom-Up Practice Led Approach

I propose that this tool, shown in Figure 38, would work with organisations, groups/teams and individuals. Inclusion is often driven by legislation, such as the DDA (1995), which is top down. This often causes an organisation to take on a top-down approach to inclusion. This tool accepts the legislative imperatives, but encourages people within organisations to work from a practical bottom-up approach that reduces the social distance (Mastro et al 1996) between the individuals, those within the organisation and the individuals they seek to serve.

For the designer, therapist and coach this tool is important because it allows people to focus on practical needs, which can then be broken down into tangible actions. It also means that if practical steps are taken, then the needs of the lead users (Keates and Clarkson 2004) as activists are taken into account.

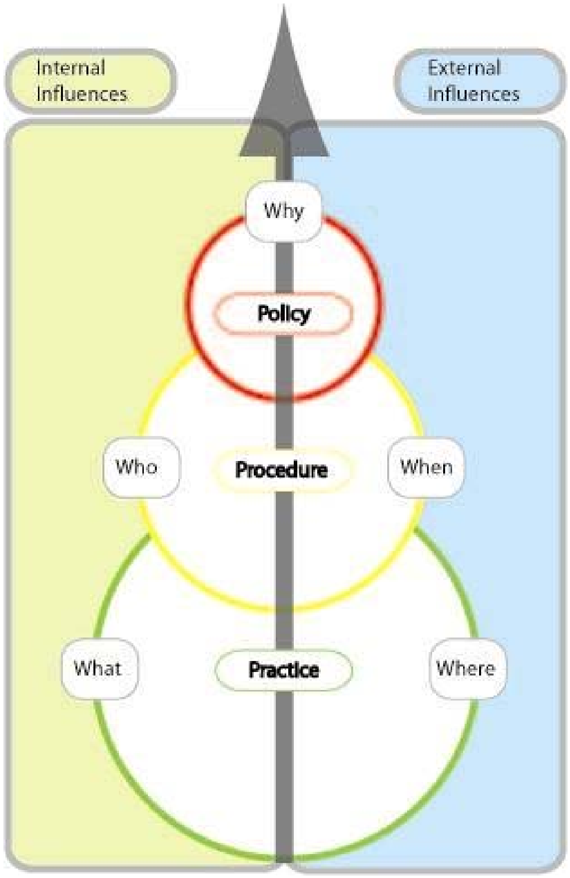


Figure 38 Practice led approach

Together the 'Bottom-Up Practice Led Approach' and 'Fear, Fear and Fear' models allow stakeholders to reveal to themselves their own internal barriers. I recognise that this does not provide a solution to the problem of inclusive adventure, but it does suggest a solution to overcoming the organisational barrier to inclusion in adventure sport. I suggest that the ‘Fear, Fear and Fear’ model provides a framework to create effective support and training for staff, and provides a way of attributing often limited resources to the development of inclusive opportunities.

7.2.4.1.3. Model of Inclusive Adventure

This section provides a model of access to the outdoor environment that can be used in many different ways, including for an access audit, as a staff training tool, and as an adventure or activity programming tool. In the centre of the model the area marked ‘People’ can be used to denote the addition of model function as given in Figure 43 Person-centred positive functional tool. The model is initially presented in its paradigm specific form, in Figure 39, and then in its broader social context, in Figure 40.

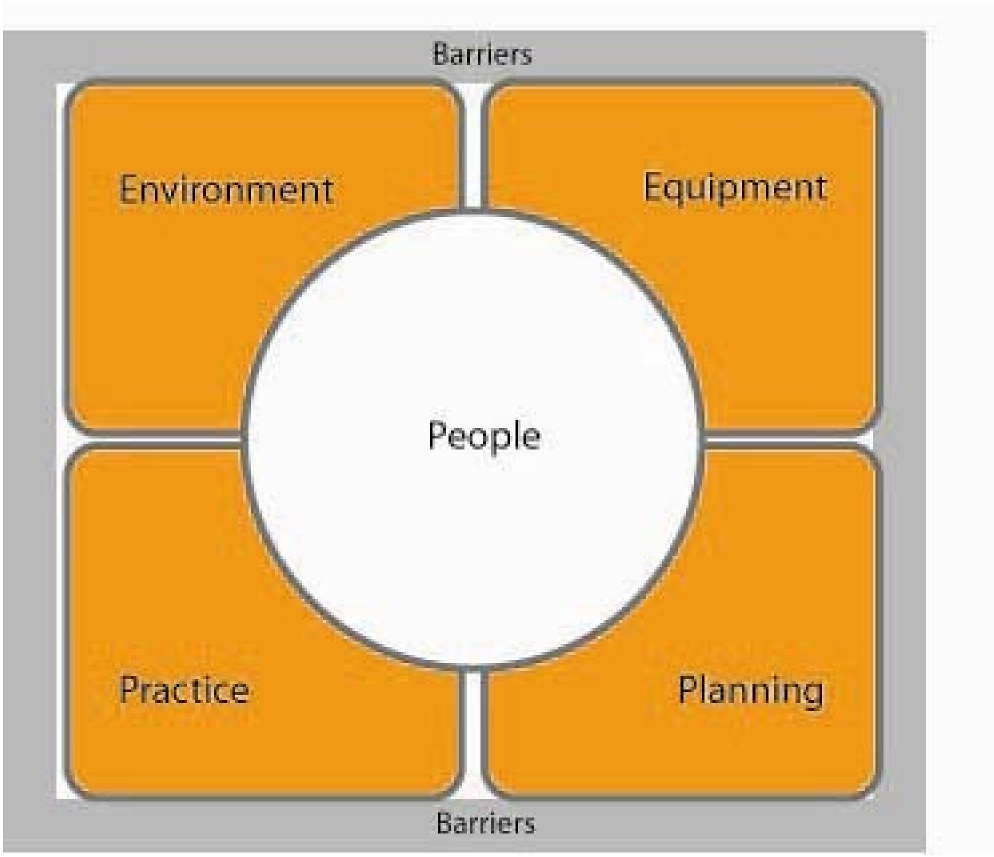


Figure 39 Functional aspects of inclusive adventure

For all participants and stakeholders the model can be used as a tool to enable the breakdown of learning into smaller components, helping to reduce the 'stickiness' (Horn 1998) of the information. For the researcher it defines the issues surrounding the proposed design research problem. For the coach it should help them to focus their coaching and simplify their approach to adapting the activity, choice of environment or their coaching practice. For the therapist it should provide an overview of the humanistic approach and provide a stepping stone to occupational models, such as the Canadian model of Occupational Therapy (Law et al 1994). For the performer it should help focus learning, or break down the areas so they can learn about one factor at a time.

The proposed model, shown in Figure 39, can be placed around the positive functional approach (see Section 7.2.4.1.6). The model captures the core components of outdoor activity and outdoor sport. The key components are: the practice, the planning of the activity, the environment and the equipment. Most important is that people are at the core of the model, such that whatever component is being addressed, it is the people involved who should provide the startpoint for any action planning.

The model can co-ordinate input from the athlete, coach, sports designer/ researcher, rehabilitation or clinical practitioner, encouraging them to liaise together to the overall benefit of all. To be successful it involves all those involved understanding the true nature of access. This generates a range of questions, a sample of which are given in Appendix E, which I recommend as an area for future work.

Finkelstein and French (1993) introduce the notion of barriers. Figure 40 provides a broader model that places societal barriers around the model of inclusive adventure. The purpose of this broader model is to remind the professional of the barriers faced by disabled people in society that must be addressed before they can enter the inclusive adventure arena, either in a participative or developmental capacity.

The Sensory Trust (2005) suggested that there are barriers to visits to the outdoors by disabled people. They identify 'the access chain' (Sensory Trust 2005), from the time an individual chooses to participate in an activity, through their experience of the activity, to their journey home. Should any part of the chain be broken, the individual may at best have a negative experience or may at worst be prevented from participating.

I suggest that the broader model of inclusive adventure provides a framework for those involved in the internal aspects of development and those involved in the broader social context. In this broader model people remain at the centre, but I acknowledge that action to create resources or opportunities or remove barriers can be initiated from any point in the model. The model does not therefore negate the need for judgment on the part of the practitioner, but it does provide a structure to ensure that interrelated issues can be dealt with and conflicts or gaps in service provision identified.

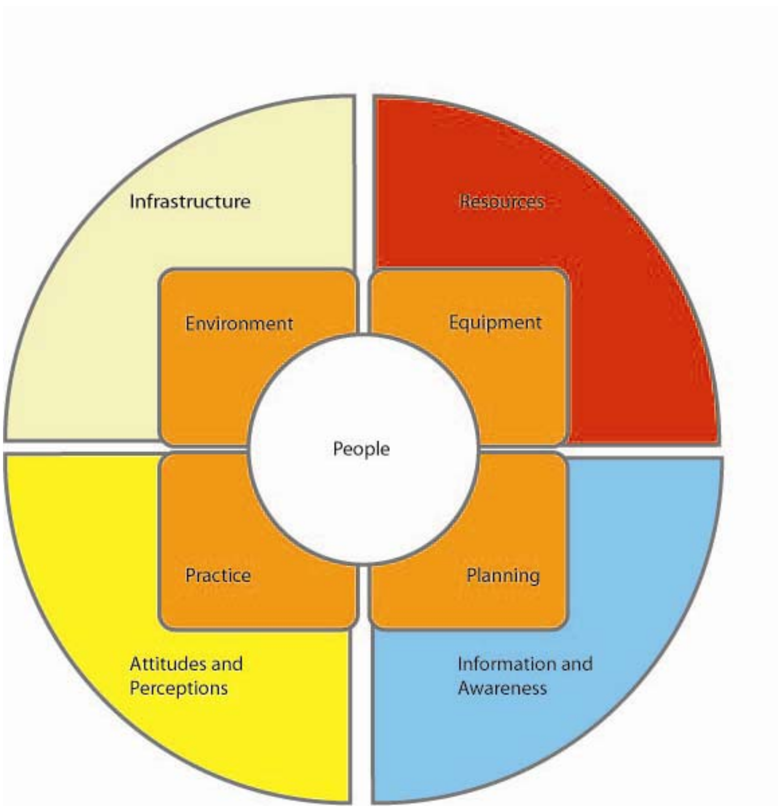


Figure 40 Social and functional aspects of inclusive adventure

7.2.4.1.4. *Utilising Inclusive Expeditions and Field Trials in Research and Development*

In Section 1.11.3 of the literature review I argued for the use of expeditions as part of the development process. The model given in Figure 41, clarifies the use of field trials and expeditions as part of the development process. The aim here is to ensure that there is a balanced outcome in terms of research, community benefit and benefit to individuals. The tool could be used to set objectives and identify follow-up actions. From an ethical perspective, the tool can be used to help clarify to the participant the nature of the proposed field intervention, or the level of experimentation to which they are likely to be exposed, such that they move towards becoming a primary risk taker (Ogilvie 2005).

For the researcher, the model suggests the level of immersion within the research process. From a community perspective, the tool recognises that participatory research, or the design and development process, takes place in a social setting. Similar to other forms of action research it involves individual contracts between the researcher and each participant, which when working with a group build to form a social or group contract. The type of engagement with the community should take into account the following factors; time scales and resources against expectation, the nature of the participants in terms of whether they are critical or lead users (Keates and Clarkson 2004), the type of product or problem being considered, the distance to market.

The tool identifies ways by which desk and base-line data collection, low cost short field trials and involved inspirational expeditions should be combined with an inclusive design process for best effect in terms of design and social outcomes.

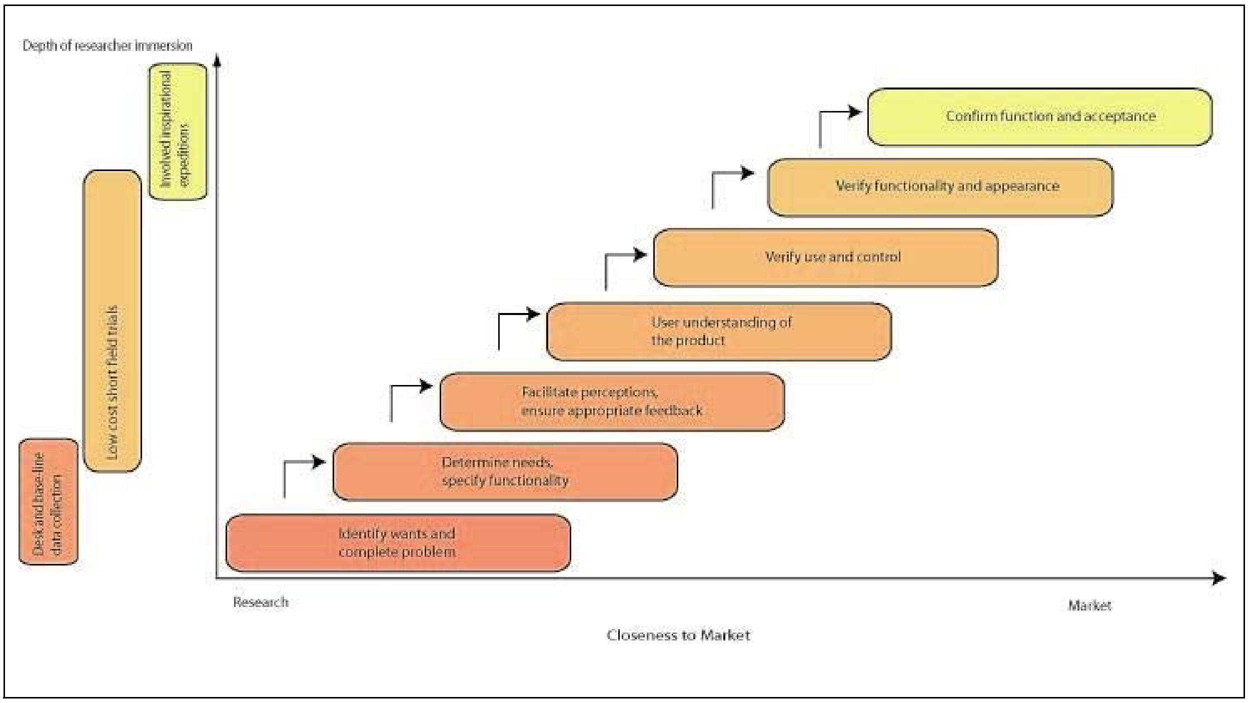
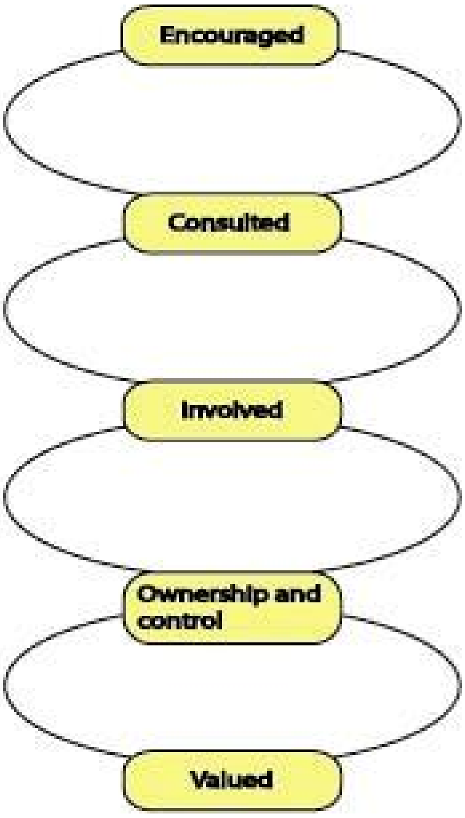


Figure 41 Utilising Inclusive Expeditions and Field Trials in Research and Development

7.2.4.1.5. VOICE – Engagement tool

Figure 42 Voice Engagement Tool outlines the VOICE engagement tool. The aim of this tool is to help ensure that all of the participants' input is heard at each stage of a design research process. I suggest that this tool can be used as a checklist for project development on a macro level of a project. For the design researcher working one-to-one, or on a micro level, the tool may also be used to help ensure the quality of individual interactions.



V	Valued feeling from the outset
O	Ownership of their body and what they do with it
I	Involved at every stage of the problem solving or decision-making process
C	Consulted - their opinions should be requested at every stage
E	Encouraged and enabled to participate independently

Figure 42 Voice Engagement Tool

This tool ensures that, should the participant choose to leave the project at the end of a phase but before the design researcher has finished or completed their overall research project, there has been a fair exchange such that both the participant and the researcher are able to move forward independently.

7.2.4.1.6. Person-centred positive functional tool

People differ. The coach and design researcher require a framework that allows them to understand user or athlete factors without being wrapped up in detail. I argue that sport, design research and clinical practice often take a different stance when looking at the way in which people function.

The need is to create a framework that allows the participants to perform, whilst at the same time allowing for the practitioners to contribute in a manner that does not negatively change the nature of the performance. To stay in line with the sporting context, the approach needs to be simple and positive, starting with a user-centred process. Therapists traditionally look at human function from a clinical or medical standpoint that improves function, but uses clinical or medical tags of diagnoses. Although the ICF (WHO 2001) promotes a functional model, it is largely negative in its approach as it focuses on functional deficit rather than functional ability. Even with an awareness of the ICF (WHO 2001), I suggest it is still common practice for medical practitioners to consider disability in a largely medical context. I suggest that the complex jargon and lack of control of outcomes by the participant within the medical approach can distract from the positive educational message that is innate within sports coaching. I suggest that this is not the most helpful to the sports equipment design research process. I suggest that there is a need to focus more on a positive functional approach in order to reduce the 'stickiness' (Horn 1998) of the information and to ensure that the performer considers their performance in positive terms. Inclusive design models, such as that by Keates and Clarkson's (2004), take a functional approach that I suggest is progressive but negative, and not too dissimilar to the ICF (WHO 2001). Sports coaching works by taking a positive stance (Cross and Lyle 1999), informing participants about what to do to improve. I suggest a combination of the positive aspects of coaching suggested by Cross and Lyle (1999) and the functional approach of Keates and Clarkson (2004) will help participants to focus positively on their performance, reach their flow state and reveal the true nature of their sporting experience. Meaden (1991) started from a similar framework in the development of her classification system, which has been used in competitive disability sport by the IPC (2006b).

I propose a positive functional tool based on the ICF (WHO 2001) and Meaden (1991), as shown in Figure 43.

This tool provides a top-line summary to help project contributors to come back to key principles while formulating the problem statement, or developing the outline of an outdoor programme. Additionally, it provides an aide memoir that helps to encourage conversation between the participant and coach or designer in a positive functional manner. It translates functional clinical concepts of disability into coaching concepts for use in the preparation of outdoor programmes in a manner that can be understood and used by the participant, coach and design researcher.

The model should be approached from the left-hand side, to consider communication before stacking, environment and other factors, before finally analysing physical factors.

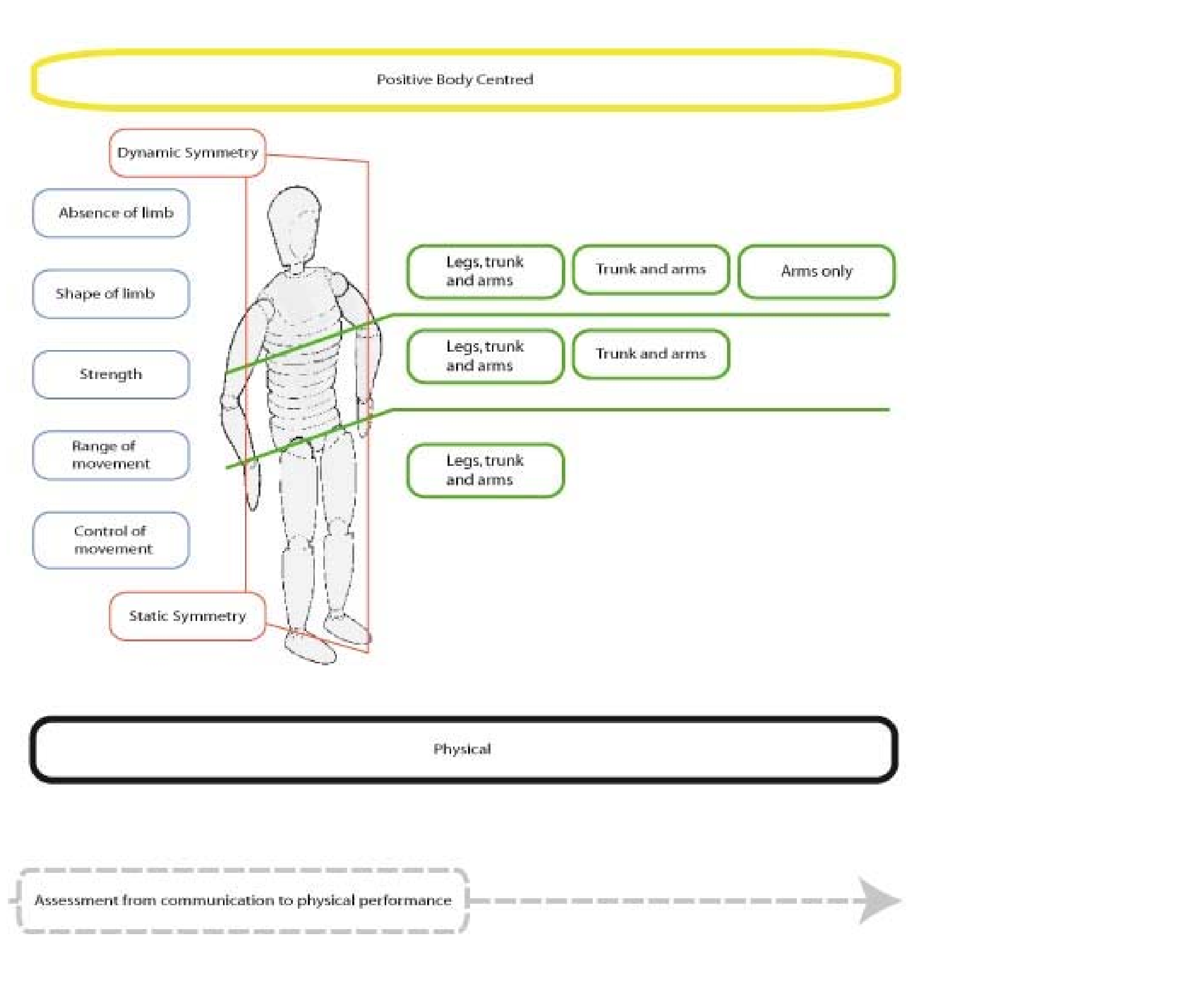


Figure 43 Person-centred positive functional tool

NOTE: This model can be used in conjunction with the Model of Inclusive Adventure given in Figure 39 Functional aspects of inclusive adventure as well as in Figure 40 Social and functional aspects of inclusive adventure.

A 'sense-able' approach involves considering communication from a positive educational standpoint. I suggest that it is possible to map Fleming and Mill's (1992) VARK model onto communication approaches for educational purposes.

I recognise that learning style does not always map to specific impairment, but when used in training Fleming and Mill's (1992) VARK model may demystify impairment for the practitioner, even if the techniques require fine-tuning according to the nature of the individual person. Rather than considering impairment, I would suggest that the athlete is considered to be auditory, visual or kinaesthetic in their learning. I suggest that the techniques used by the practitioner should include numbering, use of texture and use of colour.

A 'stacked' approach involves ensuring that the practitioner, when accepting that people differ, utilises a 'sense-able' approach to skills and techniques as they plan and work with the individuals, and in their use of standard or adaptive equipment in the manmade or natural environment. Numbering, use of texture and use of colour can be applied to parts of the body, applied to standard or adaptive equipment, and utilised as markers or signposts in the manmade or natural environment. This may also help athletes with sensory impairments, learning disability and mental health problems, which I propose should be an area for future study.

A body-centred approach categorises people into leg, trunk and arm athletes, trunk and arm athletes, and arms only athletes. Each of the three categories can then be sub-classified into dynamic or static, symmetrical or asymmetrical. The following factors should also be considered; absence of limbs, shape and length of limbs, strength, range of movement, control of movement.

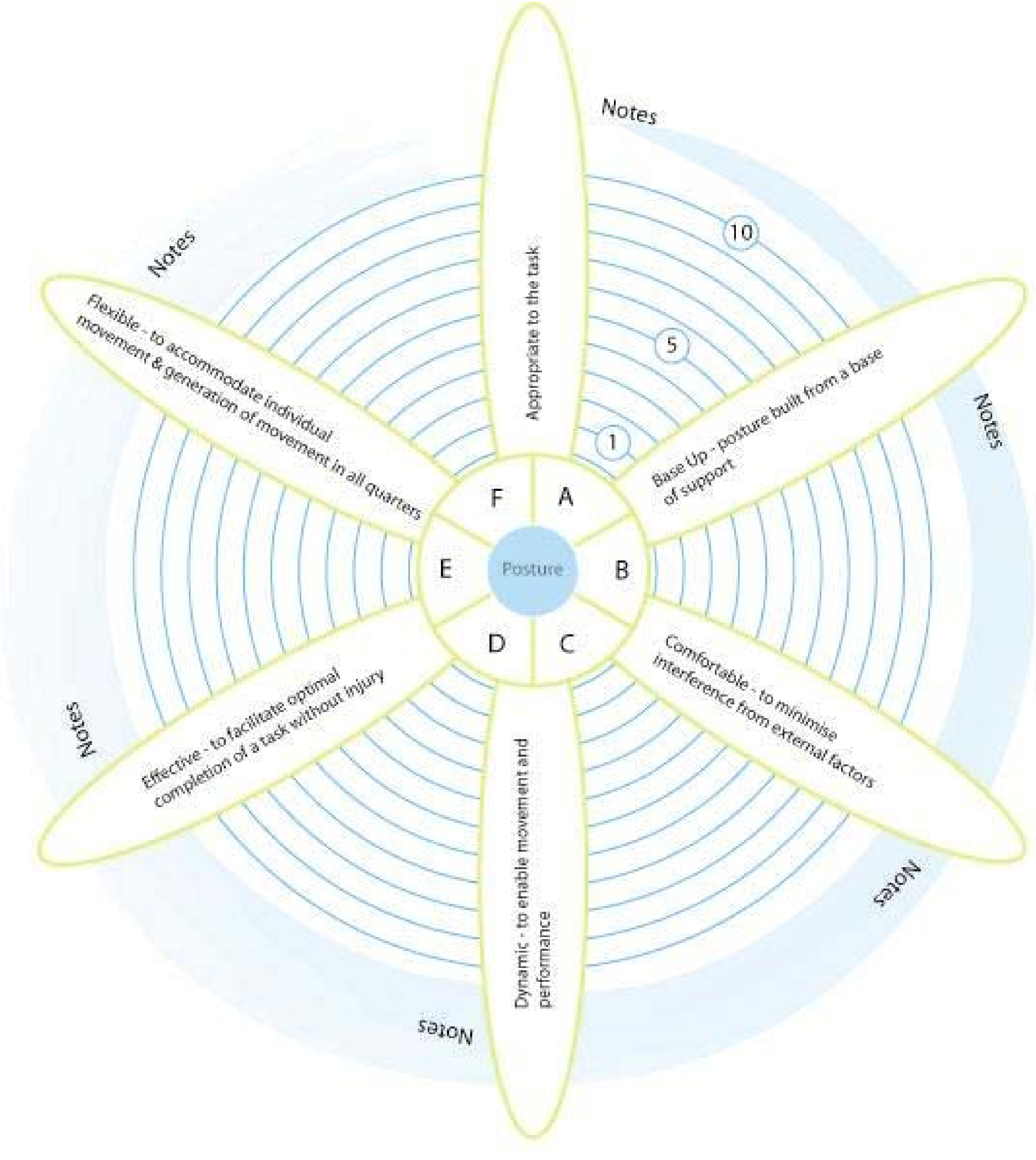
7.2.4.1.7. Model of Posture

The aim here is to summarise the characteristics of posture and facilitate the involvement of the participant/athlete, coach, therapist and design researcher, who tend to approach the solutions to 'wicked problems' (as presented in Section 7.2.1.3) differently.

The tool in Figure 45 provides a checklist against which it is possible for any of the stakeholders to evaluate and create a seating solution.

	Factor	**Justification**
A	Appropriate – task oriented	Goodman (1989) Brown (2002) Morris (2006)
B	Base Up – posture is built from a base of support	Campbell (2006) Cox (1992)
C	Comfortable – to minimise interference from external factors	Campbell (2006) Goodman (1995)
D	Dynamic – to enable movement and performance	Campbell (2006) Morris (2006) Aissaoui et al (2001)
E	Effective – to facilitate optimal completion of the task without injury	Campbell (2006) Norris (2000)
F	Flexible – to accommodate individual range of movement and generation of force in all quarters	Cox (1992) Morris (2006) Goodman (1995)

Figure 44 Checklist for Model of Posture



Instructions
1. Start at 'A' and finish at 'F'
2. Assess each element of posture and grade it using a scale of 1-10 (10 being high and 1 being low)
3. Colour in the relevant ring to record your score against each element
4. Record your notes in the relevant segment

Figure 45 Model of Posture

Figure 44 Checklist for Model of Posture provides a detailed map of the key points provided in Section 3.3.3of the literature review.

Poor postural control leaves the spine vulnerable to injury (Norris 2000). People with SCI have been identified by Goodman (1995) and Aissaoui et al (2001) as having a range of functional deficits that adversely affect their ability to independently self stabilise, and their subsequent task performance. The literature review revealed the importance of postural stability for paddlesport performance, with specific guidelines for optimising technique provided by Campbell (2006). Due to the nature of the variety of different forces being met during paddlesport activities, as identified by Morris (2006), there are both active and static postural requirements unique to each given situation. Campbell (2006) and Cox (1992), among others, identify the importance of posture coming from the base of the body. The tool can be used as a checklist to help replicate the function of the active support system, to reduce the risk of further injury to performers with SCI, and also to optimise their efficiency when paddling.

7.2.4.1.8. Field Assessment and Recording Tools

All of the data gained in the studies comes from people. I recognise that there is an inevitable amount of data reduction during the data collection process. Time in the environment, performance bursts and resources are finite. I agree with Miles and Huberman (1994), who state that the aim is to ensure quality in data collection, data display and data reduction, but I also suggest that a primary objective for the researcher must be to balance resources against the data capturing and manipulation process. The fieldwork revealed the importance of ensuring accurate live recording in the field that can be completed as close to the experience as possible.

The fieldwork revealed the need for the following control measures, which can be seen in full at Appendix E:

- Anthropometric Assessment Tool, to capture the critical measurements of the performer, to ensure that any equipment solution meets their needs.
- Readiness to participate questionnaire, this tool is based on function, to capture outdoor athlete information about whether and how they are safe to participate.
- Field- based Questionnaire, as used in Study 10

The aim of this tool is to provide both the participant and the coach/researcher with a greater understanding of the participant's functional requirements. It holds the participant at the centre of the process. It acts as an education tool for all those involved, and initiates a common language for problem solving from the outset.

7.2.4.1.9. Equipment Performance Relationship Tool

I suggest the model presented earlier, in Chapter one, Figure 11 Where is the real problem (Paul 2005, p.5), which has been used within the field-based research during discussions with the athletes, and has helped the researcher, particularly in Study 10, to confirm the validity of the tool. In Study 10, the researcher used this tool to re-evaluate the AQUABAC for use in sea kayaking and it helped to identify or clarify the design objective, that novice sea kayers with SCI can use the AQUABAC. It therefore allowed the research to focus solely on the creation of equipment that supports intermediate performers.

The tool has been updated, as shown in Figure 46, to include different levels of performance.

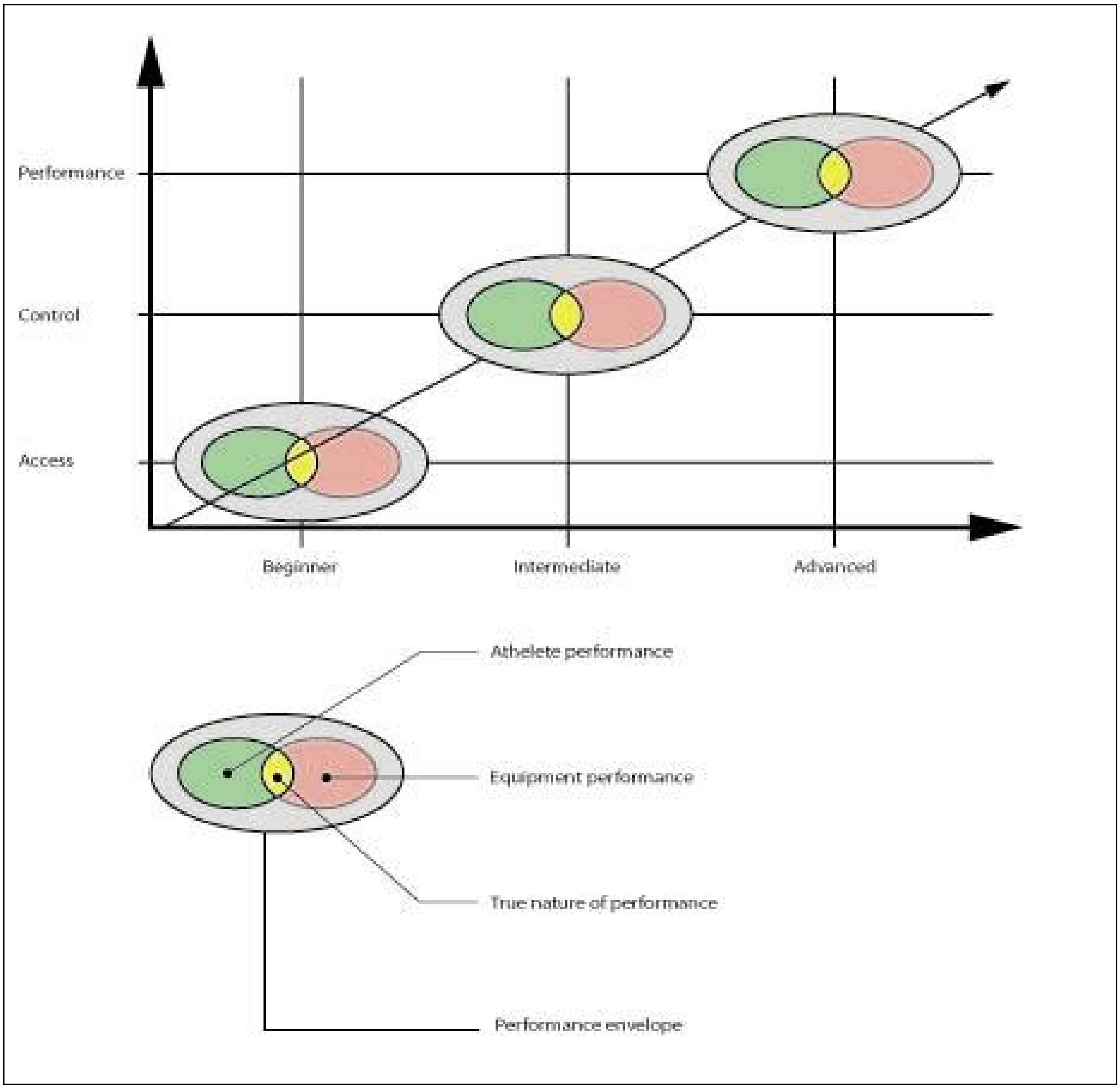


Figure 46 Equipment Performance Relationship Tool

I suggest that a performance envelope, which encompasses their need, rather than any want, for equipment to sympathetically remove functional deficit, surrounds performers. The performance envelope is made up of the equipment performance and the ability of the performer. I suggest that the equipment should sympathetically maximise the functional capacity of the performer, freeing them to use their functional ability to its optimum.

I suggest that the needs base of the elite performer, is such that they have no choice but to select the most effective equipment should they wish to perform to win. At the elite level, it is necessary for the design researcher to tailor equipment to individual functional requirements that support performance. I suggest that for the beginner/novice, although they may choose to invest in equipment, they actually only need equipment that is simple and low in cost, to enable them to access the sport. I suggest that the greatest challenge for the design researcher is to provide equipment to suit the needs of the beginner/novice, as low cost equipment needs to meet the requirements of a wide range of functional abilities. I also suggest that an intermediate performer requires equipment that improves their technique and control. The equipment needs to be adaptable to different performers, different environments and different variations for the sport, while still being mindful of resources, including cost.

7.2.4.1.10. Tracking the Research Process: Keeping Your Eye on the Ball

This tool was presented earlier in the research as part of the literature review, in Figure 9 Keeping Your Eye on the Ball Model (Paul 2005) showing the changing nature of the sports design sphere – where does the designer define the start of the problem?. The tool provides the design researcher with a better understanding of the problem they are seeking to resolve. I suggest that the wider apart the lines labelled ‘The Designer’s Understanding’ and ‘Design Application’, the more complex the ‘social mess’ (Horn 1998) and therefore the more ‘wicked’ (as presented in Section 7.2.1.3) the problem. I also suggest that the tool needs to reflect the different views of the different stakeholders, not only the design researcher, but also the participant, therapist and coach. By including these additional views into the tool, the nature of the ‘social mess’

(Horn 1998) becomes more obvious. The revised tool, given in Figure 47, now contains a representation of the lines of enquiry of the different stakeholders. The better the practitioners are at taming the problem, the less distance there is between the outside parallel lines and the more sympathetic, or closer, are the lines of enquiry of the different stakeholders. It is also possible to consider that the wider the lines of enquiry are apart the greater the 'Social Mess' or more 'Wicked' the problem.

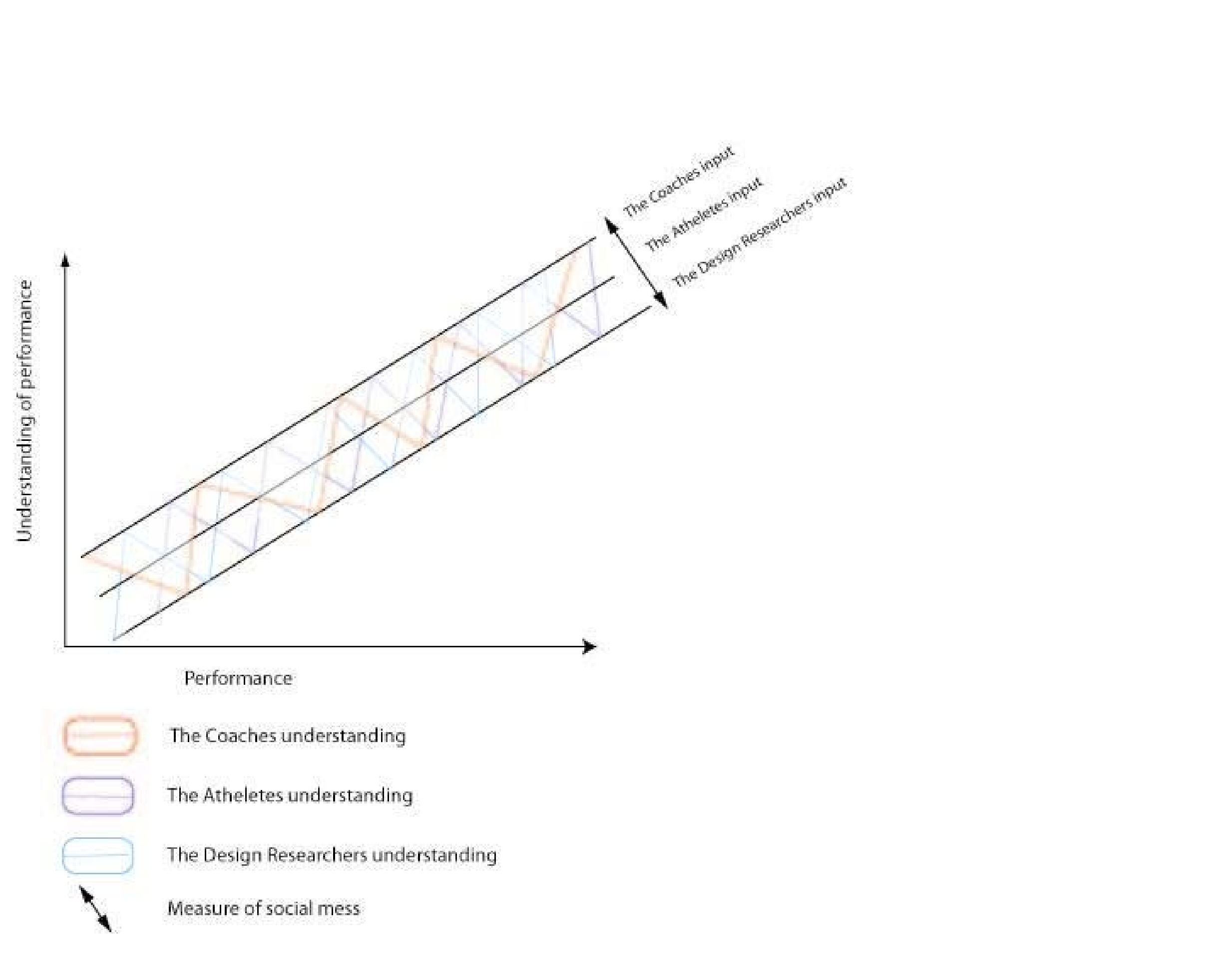


Figure 47 Keeping your eye on the ball (2)
Modified from Figure 9 Keeping Your Eye on the Ball Model (Paul 2005) showing the changing nature of the sports design sphere – where does the designer define the start of the problem?

7.2.4.1.11. Developing Inclusive Sports Opportunities

The tool presented in this section addresses the overall organisation of resources, for their creation for inclusive adventure, which has already been identified as a ‘wicked problem’ (as presented in Section 7.2.1.3).

Hylton and Totten (2001) identify the policy life cycle, in which they suggest that sports development policies evolve in a cyclical manner, inspired by a problem. They suggest that the problem is defined, responded to, options are evaluated, options are selected, options are implemented and policies are evaluated. The tool shown in Figure 48 Developing Inclusive Sports Opportunities, seeks to link the cyclical ‘policy life cycle’ to one of the ‘wicked problem’ (as presented in Section rhino) characteristics, to show that the problem is often not the responsibility of one organisation. Equipment manufacturers and national governing bodies all have a role to play, but the tool shows the complexity of the ‘wicked problem’ (as presented in Section 7.2.1.3) prescribed within the outer circle of the tool, and breaks it down into stages to be addressed by one organisation with more than one department, or by several organisations who become partners in equipment development or provision of opportunities. The tool helps the researcher to understand the potential impact of the research intervention on the community. In essence, the model describes the sporting resource and opportunity development process as action research.

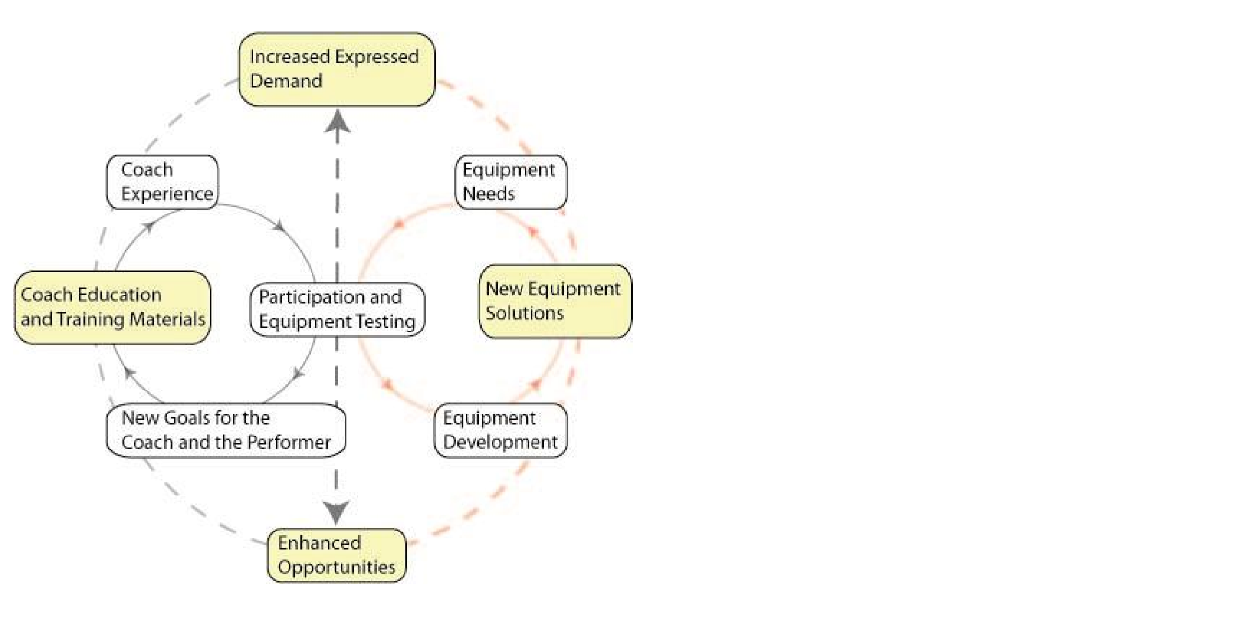
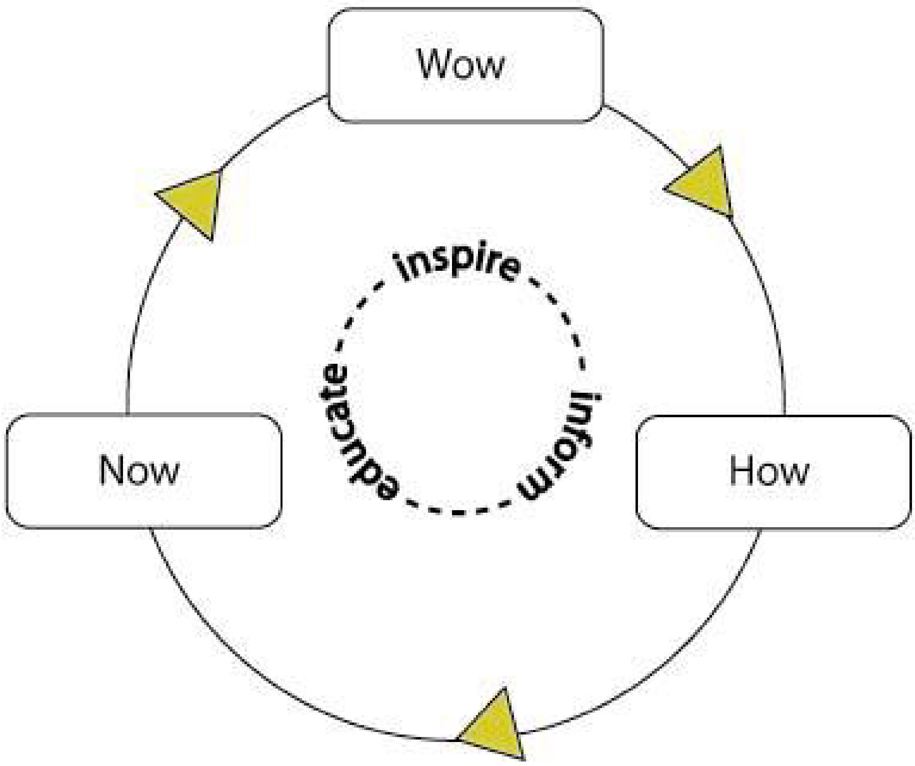


Figure 48 Developing Inclusive Sports Opportunities

7.2.4.1.12. Inspiring Change, Involvement and Adoption – WOW-HOW-NOW

The proposed WOW-HOW-NOW tool presented in this section at Figure 49 provides an inspirational framework for a collaborative community-based approach. The tool creates a foundation for a knowledge exchange cycle for inclusion, health, sport and design. Based on an educational approach, it helps to translate policies into resources.



WOW – inspire inclusion through training outcomes, equipment development and information HOW – inform the development of solutions, skills and knowledge to create real world solutions NOW – educate current practitioners to support the uptake of inclusive practices and create blueprints for future use

Figure 49 Inspiring Change, Involvement and Adoption – WOW-HOW-NOW

I suggest that design is part of social development and as such can be based on learning or pedagogy. It should be person-centred, participatory, positive and proactive. I suggest that all stakeholders within the design research process should be seen as learners. This tool not only educates but also inspires the learners, to build on educational and therapeutic approaches to change. I agree with the view of Dewey (1938), who suggests that people must be inspired if they are to learn. Through educating and inspiring the practitioners and participants together it helps them work together as a team to find common ground. I suggest that the inspirational nature of design needs to be infectious across the whole social context if social change is to keep moving forward.

Dewey (1938), Kolb (1984), Honey and Mumford (1992), Prochaska and DiClemente (1983) and Dilts (1995) all present perspectives on education and social change. I suggest that one of the key themes linking each of their approaches is inspiration. I suggest that it is important to utilise inspiration to help people change their behaviour from one state to another.

As seen in Section 2.8 of the literature review, I consider the link between design and social change. Freire (2000), suggests that education can oppress or free a community and that the most appropriate way of creating change with a community is to work directly with the community in a collaborative manner, that places both the community educator and student at the same level, rather than dis-empowering the student and over-empowering the educator. I see Freire (2000) as a link between education and social change.

The aim of the WOW-HOW-NOW tool is to provide a range of interventions to help maintain the change process in a positive direction. I suggest that change can be cyclical, as presented in the ‘policy life cycle’ (Hylton and Totten 2001), or considered as a virtuous spiral, as in this tool. Thus, the process of change is non-static and never-ending, but without inspiration I suggest it does not move forward.

Creating legacies in a range of areas means that practical barriers to participation are removed, particularly if all stakeholders understand and fully encompass the legacies in their practice. Furthermore, I propose that by involving the next generation in the development of inclusive resources for today, barriers are removed before they are created tomorrow. I consider this as an area for future work.

7.3. Review of PhD against its hypothesis and objectives

The following section reviews the PhD research project against the aim and objectives outlined in Section 7.3.1and Section 7.3.2. Section 7.3.1considers the overall aim of the research and then Section 7.3.2 takes each of the objectives. The conclusion to the research follows this review and is given in Section zebra. Suggestions for future work are presented in Section 7.5.

7.3.1. Research Aim

To research and develop a specialist seating system for intermediate sea kayakers with SCI.

This has been successful, and a prototype has been created that has been validated by user feedback. The need now is to take this prototype into production, which will require aspects of commercialisation rather than design research.

7.3.2. Research Objectives

1. To work with a number of lead users in inclusive sea kayaking to identify user wants in the area of sea kayaking for people with SCI.

This has been achieved. The field trials and expeditions involving lead users have revealed the nature of the user, the problem and provided inspiration for the development of tools to help the engagement of future lead users in the sports equipment design process.

2. To identify an appropriate method for the development of seating systems for people with SCI, through the co-ordination and observation of a multidisciplinary field trial involving coaches, therapists and lead users.

This has been achieved. Section 7.2.4.1.4 of this chapter provides the tool that describes the use of fieldwork in the research and development process (Figure 41). I propose a three-tier approach, which might involve desk research and standard qualitative and quantitative methods such as interviews, as follows; outline base-line data collection, low cost short field trials that act during the core of the inclusive design research process, inclusive inspirational expeditions to verify functionality and experience and to confirm the acceptance of the equipment.

3. To identify the performance characteristics of sea kayakers with SCI, by observing the coach and athlete at work in both individual and group settings.

A model of posture has been proposed in Section 7.2.4.1.7 of this chapter, at Figure 45, this being at the root of all performance when sea kayaking. I have been able to suggest that posture in this context is about returning core stability. I therefore suggest that the research has been successful in this objective.

4. To work with a number of coaches and performers to develop a prototype seating system through a process of iterative design.

This has been achieved and can be seen in Study 9. However, the application of detailed coaching methodologies that is implicit within this objective has only gained directional data and future work should focus on deepening and expanding upon the application of sports coaching methods into design.

5. To identify the true nature of the performance enhancement through a longitudinal study of two sea kayakers with SCI.

This has been achieved and can be seen in Study 7. However, the most useful research format revealed in this research has been shorter studies, which have lasted on average seven days in duration.

6. To test a range of seating designs for sea kayakers with SCI through a series of field trials in the UK.

This has been achieved, although due to the seasonal nature of sea kayaking, the design cycle has been based around summer field trials on an annual basis. There is a real need to take the workshop into the research environment, to provide more immediate feedback. The research has led to the creation of the social enterprise, Equal Adventure, which is based in northern Scotland, so as to be immersed in the testing environment.

7. To evaluate the model of development and seating to provide a range of tools for the further development of adventure sports equipment for disabled people.

The seating design process has revealed a range of tools that can be used to tame the sports engineering problem. These are presented from Section 7.2.4.1.1 to Section 7.2.4.1.12of this chapter. I therefore consider this objective to have been met.

7.4. Conclusions

The literature review looked at the following key elements; disability, sport, adapted physical activity, inclusive design methodologies. In addition the following were considered; ethical constraints, current understanding and practices in sea kayaking and outdoor sport for people with SCI, seating for people with SCI, methodological links between design and research.

The ten research studies took place in the UK and international settings, over durations lasting from one day to more than two months. They were utilised to reveal the nature of the inclusive sports equipment design research process.

The research has mapped the process of developing inclusive adventure opportunities with SCI to the concept of 'wicked problems', (as presented in Section 7.2.1.3). The research has considered this paradigm as a 'social mess' (Horn 1998) and suggested that when taking a multi-disciplinary approach to resolve the 'social mess' (Horn 1998), in undertaking the process so tames the 'wicked problem' (as presented in Section 7.2.1.3). The activist or researcher is presented with 'sticky information' (Horn 1998) that presents a challenge to development work. The research has presented the concept of visual language (Horn 1998) as a method of dealing with the 'social mess' (Horn 1998), taming the problem (as presented in Section 7.2.1.3) and reducing the 'stickiness' (Horn 1998) of the information within the development system. The research provides a range of tools that: summarise the objective for the stakeholders, summarise the problem, agree observational and recording methods which are open to all stakeholders, consider the social impact of the involvement of other stakeholders and the broader community, programme to provide a meaningful opportunity for all.

In practical terms this research has created the foundation development work for the 'ACTIVEBACK' a new product for intermediate level sea kayakers with complimentary balance needs. The 'ACTIVEBACK' will fit within the range of postural support products for Equal Adventure and ensure that disabled paddlers are able to move from beginner to intermediate level performance with ease.

The initial proving run of ten has been costed with a RRP of £150. Additionally participants from study 10 have continued to use their prototype and now include intermediate level sea kayaking as part of their recreational activity on a weekly and annual basis.

The research has clarified the dilemmas. If the design researcher does the wrong thing this leads to conflict with and between all the other stakeholders. This research is about ensuring design researchers do the right thing at the right time and also design the right equipment.

There is now a need to look at other types of user groups, including those with other impairments, to learn whether the tools can be extrapolated for use with populations other than people with SCI, and in other adventure settings beyond sea kayaking.

7.5. Future Work

This section provides an outline of areas for future work, to build upon the PhD research.

Each of the tools described in Section 7.2.4.1 needs to be validated. I suggest that the metric used for the validation is the 'adaptive capacity' principle, as presented by Tozer et al (2007). If successful, I suggest the tools would improve the 'adaptive capacity' (Tozer et al 2007) of the practitioners. It would also be helpful to explore the validity of the tools when applied to broader populations of communities with disabilities and broader sporting contexts.

Although the Disability Discrimination Act (HMSO 1995) outlines what is reasonable in terms of service provision and the Disability Rights Commission's (2002) Code of Practice gives guidance, there exists no definition or guidance specific to service provision in the outdoors. There is a need to find a definition, so as to increase standards of provision and meet future expectations from performers as opportunities to participate increase. Work in this area is emerging, such as that by the Countryside Agency (2005), which seeks to improve access by disabled people to land-based outdoor open spaces. I suggest that the model of inclusive adventure (Section 7.2.4.1.3), presented in the research, could be further expanded upon to help define what is reasonable in terms of provision in the outdoors.

In this research I have focussed on overall or gross factors, rather than finer details. I recognise that fine motor skills, or the manner in which products are manipulated, and product understanding are two important areas that I have not considered in this research and require further investigation.

I believe there is a need to consider more deeply the sports coaching and therapeutic links to inclusive design, through the application of more stringent coaching methods to the research process and the evaluation of therapeutic approaches and therapeutic questioning techniques. Sports coaches structure practice, constantly utilising observation throughout the coaching process (Cross and Lyle 1999); therapists utilise a range of clinical interventions in an attempt to improve the health of their patient (Law et al 1994); designers structure tests to inform them about their products (Keates and Clarkson 2004). There are techniques that could be evolved for the coach and therapist, as well as for the design researcher. This research has focussed on the role of the design researcher, but I recognise the importance of involvement by a multi-disciplinary team, who could all professionally gain from the process. For example, there is a need to develop the codified knowledge concerning adaptive kayaking techniques, including adaptive stroke techniques or safe surf-landing techniques, for the coach. These could be revealed through further field trials of prototype adaptive equipment.

This research has revealed a number of tools and frameworks that utilise mainly qualitative approaches. The need is to develop more tools and frameworks that are both qualitative and quantitative, and draw upon the techniques utilised by sports coaches and therapists. The qualitative tools I consider for future research could include linking coaching and sporting observational techniques to product design. The quantitative tools could involve linking biomechanical analysis to inclusive sports equipment product design. I suggest that Cross and Lyle (1999) provide a startpoint for the clarification of the way in which sports science, such as biomechanics, could be utilised efficiently in a sports equipment design process.

Over the past five years there has been an increase in the availability of portable digital devices which are able to be used in field research to assist the collection of both quantitative and qualitative research in the field. Equipment which at the start of this research was out of reach financially is now affordable. A review of currently available fieldwork research tools reveals the following: waterproof, digital video and camera (with helmet attachment), waterproof PDA (personal digital assistant), waterproof mobile phone with internet access, Smart pen (for writing jottings and linking with PDA, hard drive or computer, all-terrain rugged external hard drive for storing data on a daily basis, waterproof all terrain GPS tracking device and solar battery charger. Researchers such as Chang (2008) report that these items are of use and have greatly improved.

I consider there to be a need to continue the broader exploration between design research and social change, by re-evaluating the WOW-HOW-NOW model (Section 7.2.4.1.12) to create a framework to evaluate social outcomes and legacies. The Health Education Authority (1997) produced guidelines to support disabled people and those seeking to increase opportunities in physical activity with disabled people, but there has been no research investigating whether and how people are inspired to move through the stages of the trans-theoretical model of social change (Prochaska and DiClemente 1983) when applied to outdoor sports opportunities. This exploration could continue further into the arena of professional training and sports coach education.

Throughout the research process, care has been taken to be considerate to people's needs and dignity, to nurture professional relationships, and to respect the outdoor environment. Whilst enabling disabled people, it is important not to disable the environment. In line with this, and in view of the fact that outdoor equipment often utilises manmade materials that are currently challenging to recycle, I consider there is a need to research the use of recycled materials for use in new products. This is in line with the current thinking of textile technologists, such as Dr Mark Taylor from the Centre for Technical Textiles at the University of Leeds, with whom I had a telephone conversation in January 2009.

The final area I suggest requires further research is the commercialisation of the practical design element to this research. This would include the further design development of the intermediate level postural support generated in Study 9, before taking it to market, so that the design can benefit the wider population with SCI and beyond

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8.

Appendix A

Selection of Researcher's Non Academic Project Work

Projects	**Learning**	**Dates**
Pre Brunel National survey and research report on the provision and requirements of outdoor activities for disabled people.	Searching for patterns in function across different disability or impairment groups – this was an initial attempt at understanding a range of body shapes and postural requirements. The importance of the use of colour and texture to create semantics for design solutions which were open to the needs of a range of people with a variety of sensory impairments became apparent.	July 1992 – June 1993
KITE Climbing Harness	This project put research into practice and developed my understanding of niche market product manufacture. I became aware of the need for standards and testing protocols to ensure that equipment was compliant to European Standards	July 1992 – Dec 95
National trials for the KITE Harness	I became aware of the reluctance of National Governing Bodies to become involved in the development process and I learnt the need for product-specific and disability awareness training,	Jan 96- Jan 97

Projects	Learning	Dates
	appropriate to the needs of the user and the operational environment	
FISH Buoyancy Aid	Due to lack of funding, this project was undertaken by a student at Sheffield Hallam University. I learnt how to present my understanding of disability from a functional standpoint (rather than medical).	Apr 96 –Feb 99
British Canoe Union, London and South East Co-ordinator for Disability	As a member of the National Disability Panel I became aware of the development arena and the implications of national government sporting priorities on a single National Governing Body of sport, and how that was then translated into specific action plans for the development of opportunities in paddle sport for disabled people.	Jan 1996 – July 2001

9.

Appendix B

Research Priorities in Adaptive Physical Activity Reid and Prupas (1998, p.169)

These research priorities were as follows:

Training and/or competition effects, including changes in fitness components, behavior patterns, sport performance, classification, and daily living activities as functions of training or competition

Selection and training of coaches, volunteers, and officials, involving selection methods, effectiveness of training programme, coaches' background, and advisability of volunteer training for officiating purposes

Technological advances, including equipment and wheelchair design and modification, and design and evaluation of crutches and prostheses

Sociological and psychological aspects of sport, including intrinsic motivation; impact of sport on self-esteem, family, and society; and influence of age, gender, ethnicity, and disability on sport participation

Similarities and differences among athletes with and without disabilities, particularly from physiological, biomechanical, sport injury, and nutritional perspectives

Demographics of disability sport, including information regarding international and national athletes, and the age, gender, ethnicity, events, and classification of youth programs

Legal, philosophical, and historical bases for sport, including litigation effects, incidence of discrimination in sport, and the future of disability sport

Reid and Prupas (1998, p.169)

10.

Appendix C

Function and Spinal Cord Injury

Mobility & Movement	Full head and neck movement depending on muscle strength. Limited shoulder movement.	Limited Shoulder
Functionality of C4 Spinal Cord Injury		
	Complete paralysis of body and legs. No finger, wrist or elbow flexion or extension.	Body and Legs
	Sympathetic nervous system will be compromised possibility of Autonomic Dysreflexia.	Nervous System
	Electric wheelchair may be controlled by either a chin or "sip and puff" controller, this will vary depending on dexterity.	Electric Chair
	The person will require total assistance when transferring from a bed to a wheelchair and from a wheelchair into a car. A hoist will have to be used, possibly by two assistants for safety.	Assistance when transferring
	Complete assistance required during mealtimes.	Assistance Eating
Respiratory System	Able to breathe without a ventilator using diaphragm.	
	Assistance required to clear secretions and assistance in coughing will be required.	Assistance to clear secretions

Mobility & Movement	Full head and neck movement depending on muscle strength. Limited shoulder movement.	Limited Shoulder
Personal Care	Complete personal assistance is required. The person will need assistance with washing, dressing, and assistance with bowel and bladder management.	Complete personal care
Domestic Care	Complete domestic care is required, such as household cleaning, washing of clothes and kitchen duties, preparation of meals and general household duties.	Complete
Communication	A computer may be operated using iris recognition, mouth stick or voice recognition. Telephone can be used using voice recognition and headset.	Complex communication aids
Functionality of C5 Spinal Cord Injury		
Mobility & Movement	Full head and neck movement with good muscle strength. Good shoulder movement.	
	Complete paralysis of body and legs. No finger or wrist movement. No elbow extension, good elbow flexion.	Finger, wrist elbow
	Sympathetic nervous system will be compromised, possibility of Autonomic Dysreflexia.	
	Electric wheelchair can be controlled with a hand control for uneven surfaces. A manual wheelchair may be used for short distances on flat surfaces.	Electric Wheelchair User
	The person will require total assistance when transferring from a bed to a wheelchair and from a wheelchair into a car. A hoist will have to be used, possibly by one to two assistants for safety.	Assistance transferring

Mobility & Movement	Full head and neck movement depending on muscle strength. Limited shoulder movement.	Limited Shoulder
	Ability to feed self using feeding strap and fork or spoon during mealtimes. Food will need cutting.	Strap fork
Respiratory System	Able to breathe without a ventilator using diaphragm. Low stamina.	Low stamina
	Assistance required to clear secretions and assistance in coughing will be required.	Assistance in coughing
Personal Care	Complete personal assistance is required. The person will need assistance with washing, dressing, and assistance with bowel and bladder management.	
	Ability to shave and brush hair may be possible with palm straps.	
Domestic Care	Complete domestic care is required, such as household cleaning, washing of clothes and kitchen duties, preparation of meals and general household duties.	
Communication	A computer may be operated using a typing stick or voice recognition. Telephone can be used using voice recognition and headset.	
Functionality of C6 Spinal Cord Injury		
Mobility & Movement	Full head and neck movement with good muscle strength. Good shoulder movement.	
	Complete paralysis of body and legs. No finger movement, no elbow extension, no wrist flexion.	
	Good wrist extension, good elbow flexion.	

Mobility & Movement	Full head and neck movement depending on muscle strength. Limited shoulder movement.	Limited Shoulder
	A passive key grip may be present by flexing the wrist backwards, but will be weak.	
	Sympathetic nervous system will be compromised, possibility of Autonomic Dysreflexia.	
	Electric wheelchair can be controlled with a hand control for uneven outdoor surfaces. A manual wheelchair may be used for short distances on flat surfaces.	
	The person will require total assistance when transferring from floor to chair. Assistance will vary for transfer from bed to wheelchair, and wheelchair to car. A sliding board may be used in assisting with the transfer	
	Ability to feed self using feeding strap and fork or spoon during mealtimes. Food will need cutting. Able to make hot drinks with adapted kettle using a "kettle tipper".	
Respiratory System	Able to breathe without a ventilator using diaphragm. Low stamina.	
	Assistance required to clear secretions and assistance in coughing may be required.	
	Additional coughing techniques can be applied to assist in coughing by leaning forward whilst exhaling.	
Personal Care	Personal assistance is required. The person will need assistance with washing, dressing, and assistance with bowel and	

Mobility & Movement	Full head and neck movement depending on muscle strength. Limited shoulder movement.	Limited Shoulder
	bladder management. Ability to empty own legbag will depend on dexterity and strength.	
	Ability to partially dress upper body, however, assistance may be required to dress lower body.	
	Ability to shave, brush hair and brush teeth is possible with palm straps.	
Domestic Care	Complete domestic care is required, such as household cleaning, washing of clothes and kitchen duties.	
	Ability with adapted equipment to prepare simple meals and simple general household duties.	
Communication	A computer may be operated using a typing stick or voice recognition. Telephone can be used using voice recognition and headset.	
Functionality of C7 - C8 Spinal Cord Injury		
Mobility & Movement	Full head and neck movement with good muscle strength. Good shoulder movement.	
	Complete paralysis of body and legs. Partial finger movement, full elbow extension and flexion, full wrist extension and flexion	
	A C7 injured person will have movement in the thumb.	
	Sympathetic nervous system will be compromised, possibility of Autonomic	

Mobility & Movement	Full head and neck movement depending on muscle strength. Limited shoulder movement.	Limited Shoulder
	Dysreflexia.	
	May use an electric wheelchair for long independent travel or uneven outdoor surfaces. A manual wheelchair may be used for short distances on flat surfaces.	
.	Ability to transfer independently from bed to chair, and chair to car. Car transfers may need assistance depending on upper body strength.	
	Ability to drive a car adapted with hand controls. Assistance may be required to load wheelchair into car independently.	
	Ability to feed self independently during mealtimes. Food may need cutting. Able to make hot drinks , may require an adapted kettle using a "kettle tipper".	
Respiratory System	Able to breathe without a ventilator using diaphragm. Low stamina.	
	Assistance required to clear secretions and assistance in coughing may be required. Additional coughing techniques can be applied to assist in coughing by leaning forward whilst exhaling.	
Personal Care	Ability to manage bladder and bowel independently will vary depending on strength and dexterity.	
	Independent in upper body showering and dressing, lower body dressing and showering may need assistance.	
	Independent in grooming, usually without	

Mobility & Movement	Full head and neck movement depending on muscle strength. Limited shoulder movement.	Limited Shoulder
	palm straps.	
Domestic Care	Partial domestic assistance is required, such as heavy household cleaning, home maintenance, and complex preparation of meals.	
	Ability to prepare simple meals and simple general household duties independently.	
Communication	A computer may be operated using a typing stick or voice recognition. Telephone can be used using voice recognition and headset.	
Functionality of T1 - T4 Paraplegic		
Mobility & Movement	Full head and neck movement with normal muscle strength. Normal shoulder movement. Full use of arms, wrists and fingers.	
	Complete paralysis of lower body and legs. Upper body strength will vary depending on level of injury, but the lower the level, the stronger the upper body strength and balance.	
	A T4 injured person will have good strength in the chest muscles, however this will get progressively weaker the higher up the injury.	
	Sympathetic nervous system may be compromised, possibility of Autonomic Dysreflexia.	
	May use an electric wheelchair for long distance independent travel or uneven	

Mobility & Movement	Full head and neck movement depending on muscle strength. Limited shoulder movement.	Limited Shoulder
	outdoor surfaces. A manual wheelchair may be used for everyday living, with the ability to go over uneven ground for short distances.	
	Ability to transfer independently from bed to chair, and chair to car. Car transfers may need assistance depending on upper body strength.	
	Ability to drive a car adapted with hand controls. Assistance may be required to load wheelchair into car.	
	Ability to feed self independently during mealtimes.	
Respiratory System	Ability to breathe normal, although respiration capacity and endurance may be compromised.	
Personal Care	Should be independent in personal care as long as no other factors are involved, ie, additional injuries, severe spasticity etc.	
Domestic Care	Partial domestic assistance is required, such as heavy household cleaning and home maintenance.	
	Ability to prepare complex meals and general household duties independently.	
Communication	Normal communication skills apply.	
Functionality of T5 - T9 Spinal Cord Injury		
Mobility & Movement	Full head and neck movement with normal muscle strength. Normal shoulder movement. Full use of arms, wrists and	

Mobility & Movement	Full head and neck movement depending on muscle strength. Limited shoulder movement.	Limited Shoulder
	fingers.	
	Complete paralysis of lower body and legs. Upper body strength will vary depending on level of injury, but the lower the level, the stronger the upper body strength and balance.	
	A manual wheelchair may be used for everyday living, with the ability to go over uneven ground.	
	Ability to transfer independently from bed to chair, and chair to car. Car transfers may need assistance depending on upper body strength.	
	Ability to drive a car adapted with hand controls. Assistance may be required to load wheelchair into car.	
Respiratory System	Ability to breathe normal, although respiration capacity and endurance may be compromised.	
Personal Care	Should be independent in personal care as long as no other factors are involved, ie, additional injuries, severe spasticity etc.	
Domestic Care	Partial domestic assistance is required, such as heavy household cleaning and home maintenance.	
	Ability to prepare complex meals and general household duties independently.	
Communication	Normal communication skills apply.	
Functionality of T10 - L1 Spinal Cord Injury		

Mobility & Movement	Full head and neck movement depending on muscle strength. Limited shoulder movement.	Limited Shoulder
Mobility & Movement	Full head and neck movement with normal muscle strength. Normal shoulder movement. Full use of arms, wrists and fingers.	
	Partial paralysis of lower body and legs. Upper body strength and balance will vary depending on level of injury, but the lower the level, the stronger the upper body strength and balance.	
	A manual wheelchair may be used for everyday living, with the ability to go over uneven ground.	
	Ability to transfer independently from bed to chair, and chair to car. It may be possible to transfer from floor to chair depending on upper body strength. It may also be possible to transfer from sitting position to standing frame independently.	
	Ability to drive a car adapted with hand controls. Ability to load wheelchair into car independently.	
Respiratory System	Normal respiratory system.	
Personal Care	Should be independent in personal care as long as no other factors are involved, ie, additional injuries, severe spasticity etc.	
Domestic Care	Partial domestic assistance is required, such as heavy household cleaning and home maintenance.	
	Ability to prepare complex meals and	

Mobility & Movement	Full head and neck movement depending on muscle strength. Limited shoulder movement.	Limited Shoulder
	general household duties independently.	
Communication	Normal communication skills apply.	
Functionality of L2 - S5 Spinal Cord Injury		
Mobility & Movement	Full head and neck movement with normal muscle strength. Normal shoulder movement. Full use of arms, wrists and fingers.	
	Full upper body control and balance.	
	Some hip, knee and foot movement depending on the level of injury. The lower the injury, the more control over movement.	
	A manual wheelchair may be used for everyday living, with the ability to go over uneven ground.	
	Ability to transfer independently from bed to chair, and chair to car. It may be possible to transfer from floor to chair depending on upper body strength.	
	Depending on the level of injury, walking may be possible with assistance or aids. Walking will be slow and difficult though.	
	Ability to drive a car adapted with hand controls. Ability to load wheelchair into car independently.	
Respiratory System	Normal respiratory system.	
Personal Care	Should be independent in personal care as	

Mobility & Movement	Full head and neck movement depending on muscle strength. Limited shoulder movement.	Limited Shoulder
	long as no other factors are involved, ie, additional injuries, severe spasticity etc.	
Domestic Care	Partial domestic assistance is required, such as heavy household cleaning, home maintenance.	
	Ability to prepare complex meals and general household duties independently.	
Communication	Normal communication skills apply.	

Appendix D

Dilemmas for Leaders of Inclusive Expeditions

The table below provides a checklist for leaders to work through prior to an expedition, to assist them with identifying and exploring their role and the impact of their role on the experience and success of the team. Each leader will inevitably interpret the points differently, according to their current level of experience and their current leadership style.

Dilemma	Reference
Acknowledge the participants' potential lack of appreciation of risk	Chapter 1
Take responsibility for risk within the framework of the research	Chapter 2
Acknowledge differing perspective and utilise a humanistic risk assessment process	5.1
Acknowledge that involvement in the research may have both physical and emotional consequences	5.1.1
Consider fieldwork in its broadest context and take responsibility for all stake-holders and sub-contractors	5.2
Balance: size of team, purpose, time in the field, cost and resources	5.2
Consider the stress that the expedition will create for the whole team and the individuals within it when collecting data	5.3
Consider providing access to reasonable risk	5.4

Identify the role of the participants within the programme as: passenger, participant, partner, practitioner	5.4
Consider your competence as a leader and your ability to foresee the consequences of the programme	5.4
Consider the participants' arousal level during the expedition	5.5.1
Work towards creating a state of flow for the participants by balancing the task, environment and equipment	5.5.1
Consider the experience of the performer in relation to the validity of their feedback	5.5.2
Consider that the performer's perception of their performance may change and may not be accurate	5.5.2
Consider utilising group methods which promote shared values within the team	5.5.3
Consider each participant's journey into a group in terms of their: task competence, acceptance by the group and their relationships within it, understanding and communication with the group	5.5.3
Consider the timing of the research in relation to the group's formation	5.5.4
Ensure that all field prototypes are in good order	5.5.5
Ensure that the participants are primary risk takers and that they understand the equipment	5.5.5
Programme and goal set to: avoid failure, ensure consent, discover the true nature of the performance	5.6.1
Consider your affect on the group and develop your style to be able to cope with the paradox of leadership Consider the social constraints and impact of the expedition and your leadership on the participants Consider your values in terms of: adventure, understanding and empathy, strategy and intellect Critically evaluate throughout the expedition	5.6.2

12.

Appendix E:

Pre Activity Questionnaire and Data Capturing

12.0. Pre-Activity Questionnaire

About You

Name:……………………………………………………

This form should be used in conjunction with an application form, which captures your personal contact details, including next of kin and medical practitioner. The form has been prepared to enable us to adapt the activities positively and inclusively. It provides your coach with important information they will need to adapt the proposed activities to meet your individual needs. The information is valid for whichever is the shorter of 12 months or such time as any of your answers change. It is your responsibility to tell your coach if any of the information changes.
The form is provided in two parts. The first part asks questions about your health, while the second part asks questions about your functional performance. Common sense is your best guide when you answer these questions. If you are unsure about how to answer, please ask for assistance.

1. Part A

Please answer the eight questions below. This will tell you if you should check with your doctor before you commence involvement in the physical activity within this field trial. Please read the questions carefully and answer each one honestly, either yes or no.

	Yes	No
1. Has your doctor ever said that you have a heart condition <u>and</u> that you should only do physical activity recommended by a doctor?	☐	☐
2. Do you feel pain in your chest when you undertake physical activity?	☐	☐
3. In the past month, have you had chest pain when you were not doing physical activity?	☐	☐
4. Do you lose your balance because of dizziness or do you ever lose consciousness?	☐	☐
5. Do you have a bone or joint problem (for example, back, knee or hip) that could be made worse by a change in your physical activity?	☐	☐
6. Is your doctor currently prescribing medication/s for your blood pressure or heart condition?	☐	☐
7. Do you have any allergies or any dietary requirements?	☐	☐
8. Do you know of <u>any other reason</u> why you should not do physical activity or anything else your coach should know about your medical health?	☐	☐

If you have answered yes to one or more questions, talk with your doctor by phone or in person BEFORE you start the new physical activity. Tell your doctor about this form and to which questions you answered yes.
You may be able to do any activity you want as long as you start slowly and build up gradually. Follow your doctor's advice about whether the proposed physical activity is appropriate and/or how it should be adapted for your safety. Be ready prepared to provide your coach with this information.

2. Part B

We would now like to find out more about you, so that we are better able to meet your functional requirements and positively include you in the proposed activities.

3. Just to Confirm – A summary of you

In the space below please outline how you positively describe yourself.

In a little more depth

Age Range:

- ☐ 16-18
- ☐ 18-21
- ☐ 22-24
- ☐ 25-34
- ☐ 35-39
- ☐ 40-50
- ☐ 50+

Can you read this sheet?

- ☐ Easily, without glasses
- ☐ Easily, with glasses
- ☐ Difficult, even with glasses
- ☐ No
- ☐ Other/notes…

Can you differentiate colour contrasts?

- ☐ Yes
- ☐ No

Can you hear me?

- ☐ Easily, without hearing device
- ☐ Easily, with hearing device, which is …
- ☐ Difficult, even with hearing device, which is…
- ☐ No
- ☐ Other/notes …

Can you reach over your shoulder as if to scratch your back?

- ☐ Easily
- ☐ Reduced range of movement
- ☐ With assistance from other arm
- ☐ No
- ☐ Other/notes…

Can you transfer from this chair to the next?

- ☐ w/c user
- ☐ Ambulant without aids
- ☐ Ambulant with…
- ☐ Easily, without aid
- ☐ Easily, with aid
- ☐ Difficult, even with aid
- ☐ No
- ☐ Other/notes…

Can you pick up this pen with your…

Left hand?	☐ Yes ☐ No
Right hand?	☐ Yes ☐ No

Can you move this chair?

☐ Yes, with ease
☐ Yes, with assistance for balance/other...
☐ No, because…

Do you exercise outdoors?

☐ More than once a week
☐ Once per month since…
☐ Less than 10 time per year
☐ Not in past year

Is there anything else you would like to tell us that may help us to improve your safety, comfort and practical involvement in the proposed activities of this field trial?

Signature Date

Thank you for your assistance.

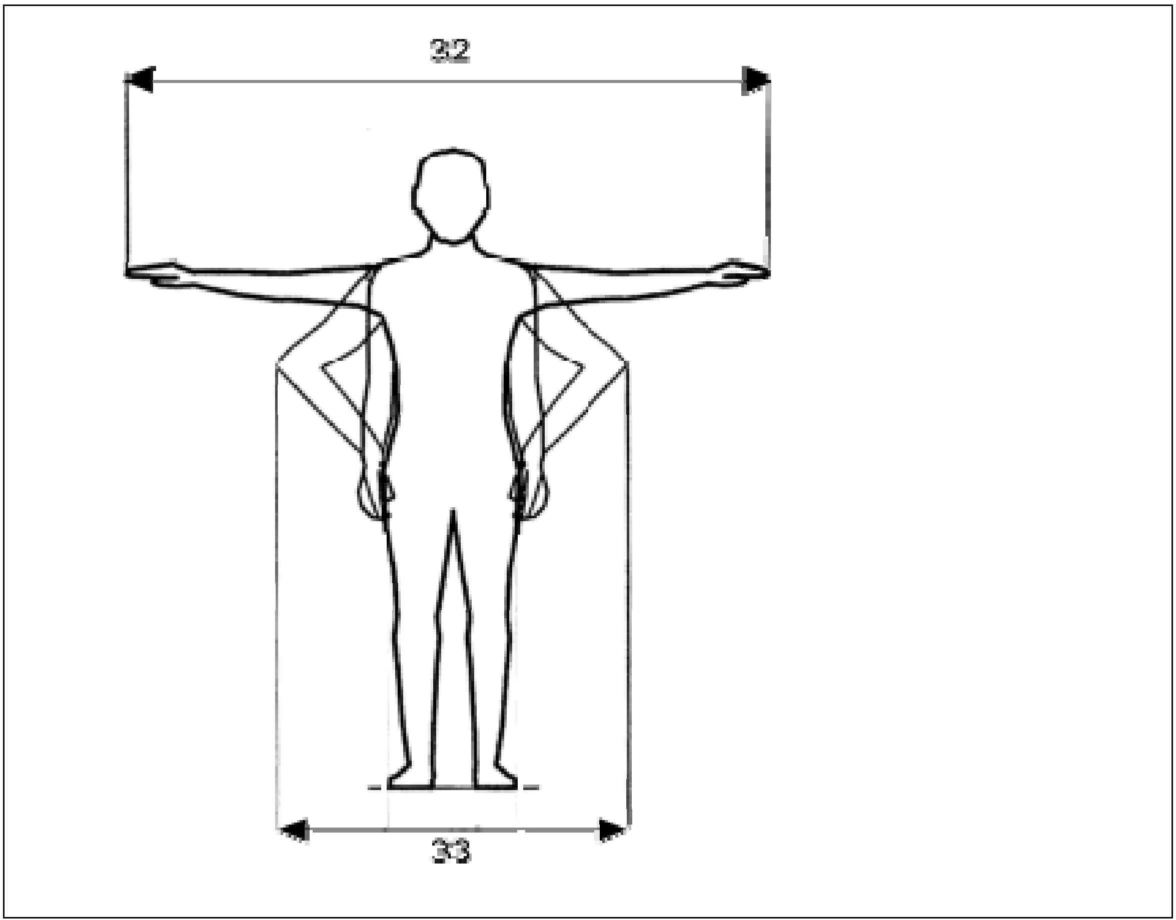
For office use only
Name of coach
Signature of coach Date
Action required: Y/N
....
....
....
....

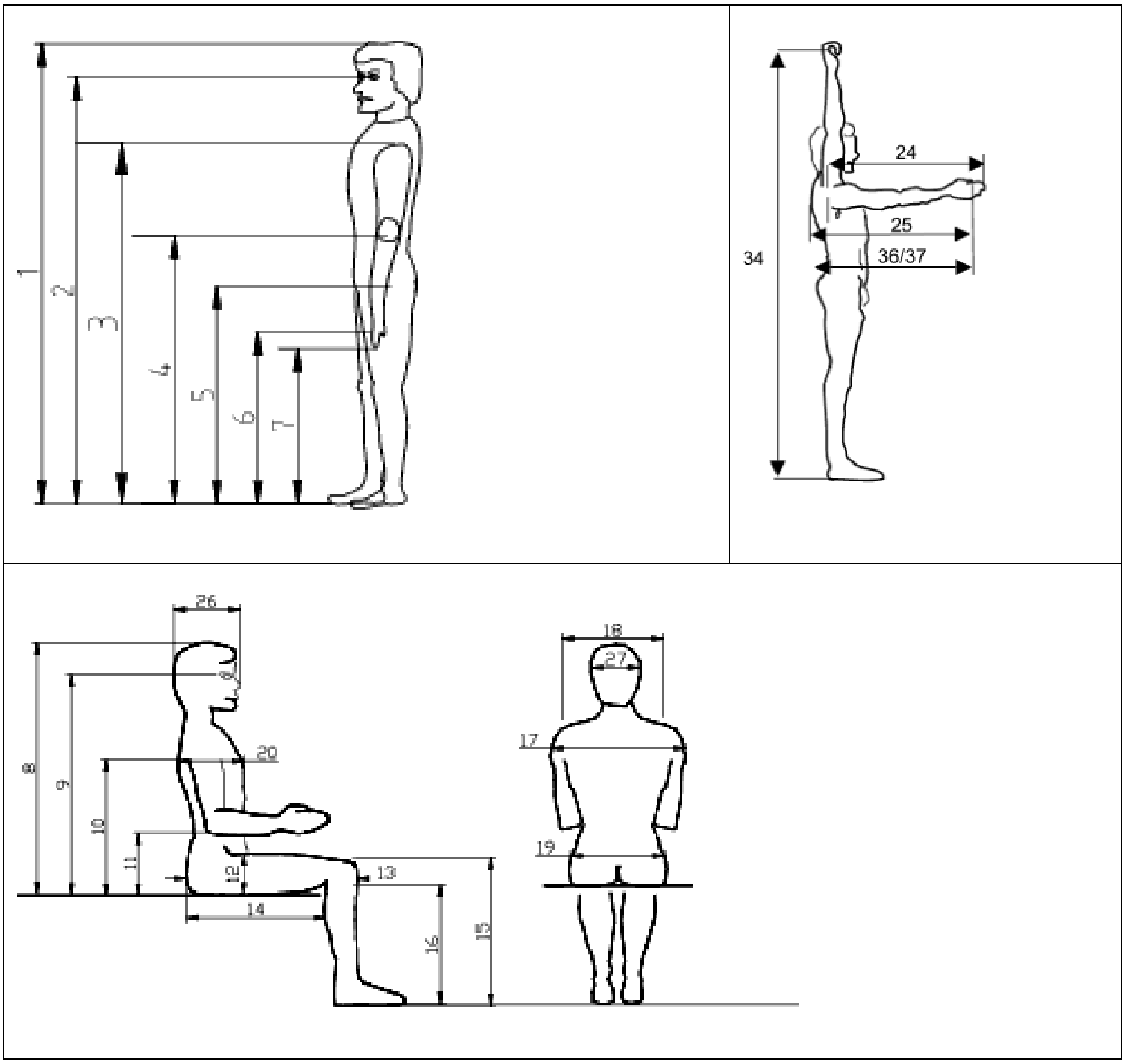
Date action completed:
....
....
....
....

Participation agreed: Y/N

12.1. Anthropometric Data Capturing Tool

Use one or more of the diagrams, as is appropriate to the participant or design problem/equipment. Mark onto the diagram(s) the relevant measurements in SI units (mm).




1
2
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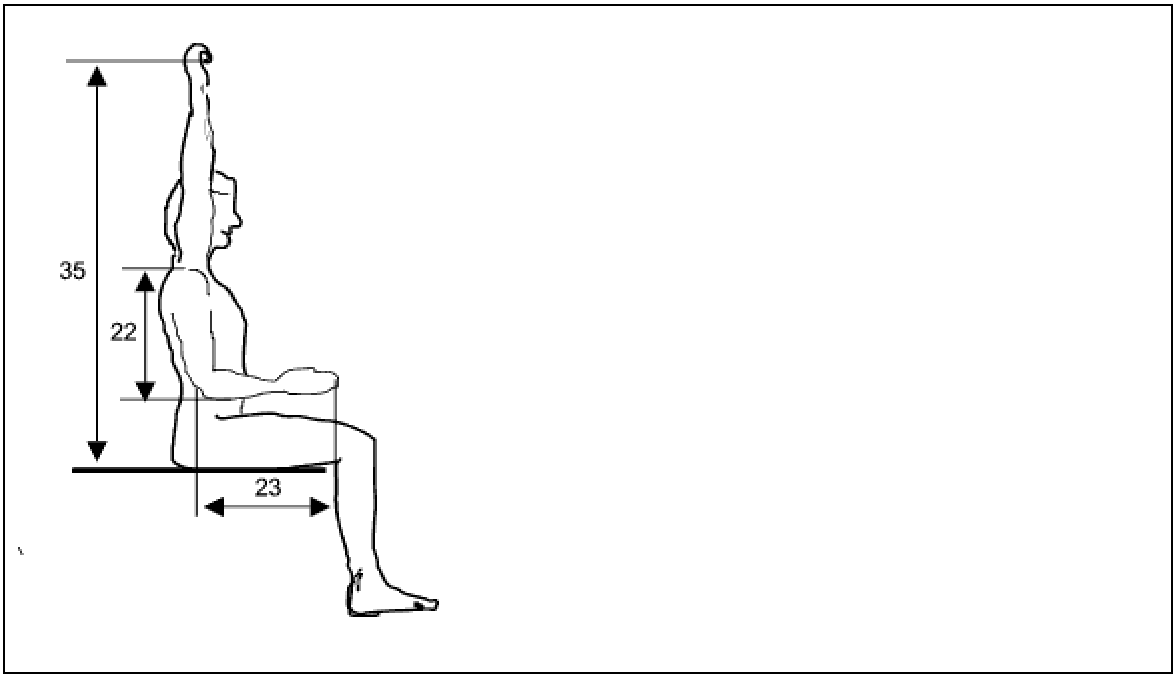
24
25
34
36/37
26
8
9
20
10
11
12
13
14
16
15
18
27
17
19


35
22
23

Measurement Index No	(mm)	Notes

Product:		**Tester:**	
Date:		**Coach:**	
Location:		**Observer:**	

Before you begin define the problem?

Define what is to be addressed, is the focus:
Product/equipment, performance or coaching technique?

In this session we are looking at….

Before you begin plan a solution

Once the problem is defined record what your collective solution is, this should be agreed between all parties (performer, coach and observer).

Describe the test environment:

Prior to testing: **THINK - Safety, Environment, Personal Care, Plan B**

Establish roles and test the solution

Record the roles of each person involved to enable to be solution to be assessed

Performer Coach Observer	

Now undertake the activity

Observations or reflections……

Record the results of the solution in relation to the problem

Where relevant answer the questions below to enable a picture to be drawn of how effective the solution was.

Did each person involved in the test satisfy their roles?

No ☐ Yes ☐ (Define)

General feedback and comments

Outline below comments and feedback from each member of the test team including any researcher/observers

On a scale of 1-5 (1 low, 5 high), how well did the solution solve the problem for:			
Tester	Coach	Product	Other (define)

Did the solution create a new problem for:		
Perfformer:	No ☐	Yes ☐ (Define)
Coach:	No ☐	Yes ☐ (Define)
Product:	No ☐	Yes ☐ (Define)
Other:	No ☐	Yes ☐ (Define)
Did the solution reduce or eliminate the problem?	No ☐	Yes ☐
Did the solution cause more problems than it solved?	No ☐	Yes ☐
Does a new solution need to be found?	No ☐	Yes ☐

Next steps - Redefine the problem Once the solution has been reviewed identify the reduced or new problems for the next round of review
Other references – tape number photo number…. For Office Use only

Appendix F

Results

12.2. Introduction to the Results

This appendix contains the results from each of the ten studies outlined in the research plan in section 6.6. The discussions and conclusions are given in chapter seven. Chapter seven commences with a summary of each study, to allow the reader to consider the conclusions in relation to the ten studies. The logistical considerations for each study are given in the appendices.

Each study supports one of the inclusive design phases, which are based on Keates and Clarkson's (2004) inclusive design schema. The studies can be considered conceptualised in five research phases or groups; reflections on phenomena, identifying phenomena, exploring phenomena, immersion in phenomena, acting on phenomena. Each study aim not only maps to one of the design phases, but also can be mapped to one of the five research phases or groups.

Section 12.3.2 provides the results from Study 1 and Study 2, which were personal reflections and can be considered as having n=1 respondents. Study 1 was a personal reflection on past inclusive expeditions; Coppermine, Israel and Ganges and selected professional design research projects in seating (AQUABAC). Study 2 was a reflection on the development of the AQUABAC postural support.

Section 13..3 to section 13.8 provide the results from studies 3 to 8, which were field trials. The data generated were created by a range of sample sizes, from n=2 to n=20. The researcher is not included in the sample number and the voice of the researcher is captured within a reflection in each study that is independent to the data provided by the respondents. The issues raised by the researcher and the respondents have been combined in this summary. Further details are available in the appendices. Study 3 (n=9) was a field trial in Iceland, 2001, designed to understand how to best use a field trial to research people-centred product design. Study 4 (n=3 for the questionnaires and n=2 for the interviews) took place in Aberdeen, 2002, and explored practical equipment issues, aspirations, and current understanding and practice with three lead user kayakers with spinal cord injury. Study 5 (n=2) was an observation of a top level sea kayak coach on inland flat water. Study 6 (n=7) was an inclusive 4 star training with Integrate Paddling/BIB in Skye, 2002. Study 7 (n=8) was a field trial from Canada to Alaska, 2003. Study 8 (n=17 for participants, n=3 for coaches) re-evaluated the efficiency of three postural support solutions for spinally injured sea kayakers, within a coached intermediate environment, based on community rather than expedition participation, in North Uist, Outer Hebrides, 2004.

Study 9 (n=1) is outlined in section 13.9 and contains a reflection, and utilised a creative design process to build on research and learning from field-based and desk-based studies to create a device which facilitates safe and efficient sea kayak performance for intermediate sea kayers with paraplegia resulting from SCI.

The final study, Study 10, returns to the field-based format utilised in Studies 3 to 8, results of which are provided in section 13.10. The researcher is not included in the sample number and the voice of the researcher is captured within a reflection in each study that is independent to the data provided by the respondents. The issues raised by the researcher and the respondents have been combined in this summary. Study 10 (n=2 for participants, n=1 for coaches) evaluated the practical and methodological product of the previous studies and research.

12.3. Study 1: Personal Reflection on Past Inclusive Expeditions; Coppermine, Israel and Ganges and Selected Professional Design Research Projects in Seating (AQUABAC)

12.3.1. Introduction

The following study takes the form of a reflection and considers both fieldwork and design experiences. The 1997 Coppermine River Expedition, 1998 Israel Field Trials and the 1998-99 Ganges River Expedition are presented in turn, providing a full reflection of my professional fieldwork in this area to date. This study satisfies two related needs that require management; the need for impartiality for the observational elements of the research and the need in the design study to take a more interpretive slant. The study can therefore be seen as a method for tuning the research machine, or a way of ensuring that the forthcoming group of studies are observational and not interpretive. The study uses the ‘Four E’ method presented by Greenaway (1993) as a means of reflection; experience, express, examine and explore.

12.3.2. Aim

To gather any additional learning from my past inclusive field-based experiences.

12.3.2.1. Setting for the Reflection

This reflection has been undertaken during the period between intense desk-based research and embarking on the field-based work for a PhD study. As such the reflection is being constructed during work or study time in a university department setting during a period of part-time research and part-time pragmatic research as Adventure Designs' Project Coordinator at the Design for Life Centre, Brunel University.

Discussions with key personnel in the AALA, including a telephone conversation with Marcus Bailey on 22nd October 2000, attendance on an Off Site Safety Management Course in November 2000, and attendance at meetings of the Expeditions and Fieldwork Committee at the Royal Geographical Society have provided a theoretical basis from which to critique my own personal outdoor practice.

12.3.3. The 1997 Coppermine River Expedition

12.3.3.1. Experience

The expedition took place over a five year period and involved fundraising and planning, preparation and training, expedition and fieldwork, reporting and education. The participants involved in the expedition are outlined in Table 37 1997 Coppermine River Expedition - Team Roles and Responsbilities. The six person field team included three participants with lower limb amputations. The twenty one day journey in the NW Territories of Canada was undertaken on a Grade 4 wilderness river the Coppermine River.

*Table **37** 1997 Coppermine River Expedition - Team Roles and Responsibilities*

Participant	**Role**
EB	Expedition Leader
SP	Deputy Expedition Leader
DR	Team Coach

Participant	Role
DS	Fund Raising, initially novice canoeist
SH	Participant
AH	Participant
JM	Expedition supporter and Publicist
NW	Senior staff at Royal Geographical Society (with IBG) and project supporter

12.3.3.2. Express

Planning and fundraising: I found this phase of the project very exciting. I was involved in mapping out possibilities and working closely with other team members in order to gather, collate and present information for the team. I found the fundraising a great opportunity and grabbed it with both hands. Again, I found this exciting and exhilarating, but found it was a real rollercoaster of highs and lows.

Preparation and training: For me this was an intense and highly enjoyable element of the project. I gained a huge amount of personal confidence in my own ability. However, I felt frustrated by not being able to contribute to the skills training of the team, and felt that my potential contribution as a paddlesport coach was often ignored. The equipment development with the team came at a time when I was stretched at work. I felt I was not able to spend as much time as I would have liked on this phase of the project. My role was therefore to gather and co-ordinate the resources.

Expedition and fieldwork: I felt at peace, busy and very alone during this phase of the project. The environment made me happy. My role in the team made me feel like I was never off duty and very solitary. I kept my own counsel.

Reporting: At times during this phase of the project I was uncomfortable. It was a time during which I and others within the department were being bullied. The negative environment at work, combined with challenges to my eyesight and lack of support from the team for writing up, made me feel very demoralised.

Education: I loved this phase and felt that the phase justified the trouble and expenditure, and some of the extravagance of the project.

12.3.3.3. Examine

Planning and Fundraising: This phase ran concurrently with the training and preparation phases. The logistics and information gathering involved phone calls, faxes and letters to contacts in the disability, canoeing and expedition worlds. This was mostly undertaken in the evenings by myself and DS. During the end of the planning phase DR took over, working closely with DS.

The fundraising involved EB, DS and me. Together we managed to raise a total of £40,000 in financial and in-kind support for the expedition.

Again, during the final lead-up to the expedition, the inter-relationship between the members of the fundraising cell within the team changed and I moved onto other tasks.

Preparation and Training: This involved training the team, developing adaptive equipment and packing. The team training took place at weekends, on UK rivers. The training was led by DR, who took the team through a BCU four star syllabus. It was especially pertinent for the disabled members of the team, who were all novice paddlers at the beginning of the expedition.

The second half of the training involved gym-based fitness sessions. My experience of this centred around attending daily two hour sessions of resistance and cardiovascular training before work. DS was again my partner in this activity.

The packing took place in the two week lead up to the expedition departure from London. This involved mainly DR and DS, to the exclusion of the other team members.

Expedition and Fieldwork: This phase involved international travel from the UK to the North West Territories. Final provisioning occurred in Yellow Knife, where all members of the team were involved.

The team split up to manage the completion of a range of tasks. My role seemed to become that of recorder of the team's activities on camera. This made me a bit remote from the team, as I was constantly looking for the best vantage point, rather than being task focused. This is not to say that I did not undertake my share of practical tasks.

Fieldwork: The fieldwork involved two strands of investigation: testing of the design of a postural support for canoeists with lower limb amputations; qualitative assessment of the effects of a sub-polar environment on amputee canoeists. The design element was led by DR. I led the qualitative study.

This was my first piece of people orientated fieldwork. My experience of this was that the research became a burden on the team. I felt they did not really ‘buy into’ this part of the project. The combination of my role as photographer and quasi social commentator made me feel even more remote to the team.

The canoeing journeying aspect of the expedition lasted just 21 days. Given my position in the team, I think I took a conscious decision at the time to take a back seat role. I designed it so that every morning I was ready, but was always the last person to leave camp and push the boat off from shore, thus always bringing up the rear. I kept my distance and kept pace with the team, placing myself as observer and recorder.

I found that my engagement with the outdoors came in the evenings. This is when I found a sense of control. I often tidied and shut down camp just to be able to do something without having to observe it.

Reporting: This phase of the project was led by me and DM, with huge amounts of support from JM, of the DLC. I found this element of the project very challenging and exhausting, this was mainly due to personal challenges with my eyesight at the time which caused challenges with reading and writing. This part of the project concluded when NW of the RGS (with IBG) made a VIP visit to the research centre. NW picked up the reports for Coppermine, Israel and Ganges and simply put them in a Sainsbury’s bag, as they were too big for his well-worn, battered and labeled explorer’s briefcase. It was the Sainsbury’s bag that facilitated the last leg of the expedition’s reports into the RGS archives. I smiled!

Education: This phase lasted twelve to eighteen months and ran concurrently with the reporting phase. Approximately one hundred presentations were undertaken by the team, to schools, colleges, disability and sports groups. I undertook a fair amount of these, often with one other team member. I enjoyed this phase and found it particularly rewarding to be able to tell the story to young people.

This element of the project allowed me to explore methods of communication and presentation. It provided an opportunity to explore ways of presenting inclusion and disability, often audiences were amazed by our story of inclusion, which upon reflection re-enforced a stereo-type of disabled people being amazing.

12.3.3.4. Explore

Planning: I found more efficient ways of planning which are less intensive and involve easier lines of communication, by the close of the planning stage I was happier with report writing styles which helped to present snap-shots of the planning process. In addition using language and phrases concerning disability, inclusion, adventure and expeditions, seemed natural, when at the start were sometime daunting.

Preparation and Training: I will take forward the quality of preparation and investigate how to create similar enabling equipment that has such a large and positive impact on the lives of the individuals concerned. I will take forward the training regime that we followed as method for preparing for challenging experiences in the field; specifically, daily routine, looking after personal kit, camp routine of shelter, food and water and preparation to ensure a state of readiness.

Education: For me this project set a new standard, in terms of the educational pay back for the investment. I feel that if we had been able to partner with an educational organisation we would have been able to formalize our educational output and had a greater impact still. This might have been through the creation of a book publication for the general public.

Conclusion: This expedition project illustrated the burden of science on an adventure orientated team.

12.3.4. Israel

12.3.4.1. Experience

Planning and preparation: This was rapid process from a project. The project was much more low-key in terms of cost and publicity than the Coppermine.

The team left the UK on a high, straight from the RGS Welcome Home event, where many of the team members had presented their involvement in the Coppermine.

After a late night flight we arrived in Tel Aviv in the early morning. The team rested before spending the next five days playing with foam, fitting out kayaks and exploring sea kayak techniques.

The camp, or ground support, role was undertaken by one of the team members. This was invaluable, as it allowed the other team members to focus on contributing to their own paddling and the research projects. The payback section of the expedition was site seeing around the ruins of Masada and swimming in the Dead Sea. The deliberate break between 'research work time' and down or leisure time, allowed the team to focus.

Fieldwork: This involved three designers, five participants and two sea kayak coaches. At the end, the fieldwork inspired a range of models which formed the beginning of the AQUABAC. The main components or elements of the initial design included: fabric base, laminate closed cell foam pads, stiffeners and rigid supports.

On return, the Israel project was included in talks to schools and youth groups and complimented the Coppermine expedition.

12.3.4.2. Express

The project was a success, the project led to the design of new equipment and all of the participants stated that they found the experience enjoyable and worthwhile. I felt that the design and fieldwork elements came together. It felt like magic. I was left feeling that the only thing that let me down was my paperwork. I could record things in my head, I could get the programme organised in my head, but I found it really challenging to express this on paper. However, by the end of the expedition I realised that a waterproof notebook, camera and a pencil were the tools of choice.

The decision making process and recording the data in an organised way was also difficult for me. I also found it challenging to work out who to include in the research process. In order to make use of the fieldwork opportunity, field experiences were often reviewed with participants in the evening which conflicted with meal times, rest and general camp routine, and was not always popular with some of the participants.

Involving the sea kayak coach in this instance was a challenge as he was a little disinterested with the equipment and just wanted to ‘get on the water’. In essence the main challenges involved gaining a sense of ‘buy in’ for all of the participants and staff team all of the time.

12.3.4.3. Examine

There needed to be better paperwork in terms of recording the planning. Some of our time in the field was taken up by dealing with basic access issues. These detracted from the fieldwork process.

The makeup of the team was great. Having so many technicians and coaches examine issues from so many angles created a fantastic resource for future design work.

In country, the only real challenge was in dealing with the different expectations between the UK and Israel. These issues included sorting out the price for the sea kayak hire. I had tried to pin down the price before the field trip and regularly during intervals whilst in Israel. I had only ever been promised a "good price". This proved to be less than true in reality at the end of the trip, when I had to pay by a process of haggling under duress of ex-Mosad agents (so they said!).

This highlighted to me the cultural influences or pressures overseas expedition can have, the continual negotiations over the use of resources reduced my ability to focus on the research objectives, as I was continually brought into meetings to discuss price and availability of standard equipment, such as sea kayaks.

12.3.4.4. Explore

The field project provided the design inspiration for the major components of the AQUABAC. On return to the studio the prototypes were laid out into a physical matrix which revealed a set of design features that were used as the basis for the modular approach to the AQUABAC.

Apart from the unexpected haggling, the overnight transport and long distance, the project was a success and all participants suggested that they felt the project was both worthwhile and value for money in terms of the experience they gained in return for their financing contribution to the research.

This fieldwork project illustrated to me the positive benefits of field-based experiences to drive a design process. The evidence of this success is that the AQUABAC postural support development project came in on time and on budget and is an award winning product that remains in demand and on the market today. This field trial created a design hot house that short circuited the development process successfully.

12.3.5. The Ganges 1998-99

12.3.5.1. Experience

This expedition involved a team of six disabled and non-disabled people traveling the length of the River Ganges in India. The project took one year to plan followed by five months spent on the river. A team list is given in **Table 38** Ganges Expedition Team List.

The preparation involved the creation of new components for the AQUABAC system, and a field toilet and storage system for use by the disabled members of the team. The additions to the AQUABAC were: 1) a rigid base board to create a firm base of support for the fabric AQUABAC when used in open canoe and inflatable raft, 2) a four-point harness that restrained the user of the AQUABAC and was releasable by the participant and had an independent all release system as a back up. The language difference was a major challenge to the logistical preparation. As a result it took a considerable amount of effort to create the outline and then the detailed plan. The training involved canoeing and the team all were competent river paddlers, so we used a Swift Water Rescue Instructor Training Course as a method for developing team cohesion prior to departure.

Table 38 Ganges Expedition Team List

Participant	Role
SP	Expedition Leader
EB	Fund Raising and Psychologist
MM	Interpreter (English to Hindi) and Navigator
MK	Audio reporter
ND	Artist
CP	Technician and web writer

12.3.5.2. Express

I felt that I was able to contribute to the planning and implementation of the expedition. I took responsibility for the expedition and did not feel that I left anything to chance. I found this exhausting. My lack of language was a real barrier. I often had to communicate through MM and this often made it challenging to represent myself. During the fieldwork phase I spent most of my time reconciling the needs of others and negotiating team priorities to ensure that the team managed to stay together to complete the journey. I felt that this was a mammoth task and went largely unseen by the team, who focused on managing their own needs in a highly dynamic and very culturally different environment. I did not feel that the leadership of this project was easy. It took all of my energy and focus, which sometimes made it a real challenge to enjoy the moment.

The team worked very hard, given the environmental challenges, and the continual need to move on to maintain a schedule which was prescribed by sponsors and other external factors.

The water quality study of The Ganges proved to be a real challenge to fit in. It was recognised that the study really was not about gathering data for scientific purposes, but was intended to reveal the issues concerned with the involvement of both disabled and non-disabled people in fieldwork on a mobile field-based project.

The bandit attack was troublesome. It changed the nature of the team dynamic and injured out one of the team members, who had to be replaced. It also placed a grey cloud over the way in which we could tell this amazing story. In effect, it gagged the expedition team from telling their story on return to the UK. This nullified the use of this project as an educational tool for a number of years.

On a personal note, I only managed to tell the story of the expedition in a truly positive light about five years following our return, when the injured team member unexpectedly turned up at a conference, smiling broadly and wiggling his fingers again, an action that had been denied him since the strike of a large stick during the attack. It was only at this point that I felt a sense of closure and that the project had come to an end.

12.3.5.3. Examine

The detail of this expedition has been lost to me in many ways; the shock of the bandit attack has left me with a distance that precludes seeing the detail. The expedition was run as a series of phases in the field which allowed for all of the team members to focus on a goal which was more achievable. Travelling the river, science work, personal care time, reflection and recording took its toll on the team. When we arrived at a hotel a cycle of cleaning, free time, repair and re-stocking ensued. Jobs were delegated in a highly organized manner. The main conflict seemed to be in the team's ability to manage its daily routine. This revolved around the time it took some individual team members to get out of bed.

12.3.5.4. Explore

Spend time learning the language so that I could negotiate directly, or undertake a project in an English speaking part of the world.

Undertake a field-based project which enabled the team and myself to experience and explore one place in detail, rather than the rapid continuous ‘film strip’, which this journey presented.

12.3.5.5. The AQUABAC and Field Toilet

Following the Ganges Expedition, it was possible to take the AQUABAC and the Field Toilet into more detailed design. Both products were able to be brought to the market, partly as a result of the in-depth understanding gained during the expedition.

For the AQUABAC the basic system developed from the Israel Expedition and the Ganges Expedition provided a second input of user data into the design process, expanding the scope of the seating system which was formalised during further user research and a cost based engineering phase. The UK user research is described in Study 2.

For the Field Toilet the Ganges expedition provided the inspiration for a product that was developed by UK based user research and further field trialing and field based user testing in Study 7. The key elements of the final design include a moulded seat which provides postural support to the user with limited sitting balance without the need for a back rest. Additionally, issues concerning the management of human waste by mobility disabled adventurers and third parties were resolved to create a product which is now available off the shelf.

Some years later, as I write this reflection, I feel that this was a huge project that had personal emotional implications for me as an Anglo-Indian. From a truly individual perspective, The Ganges provided me with a script which outlines my major experience of India as an Anglo-Indian; something which I felt had been previously denied to me.

Now older, and perhaps with a little more distance, I see that there was a great deal of value which came out of the project, not only in terms of developing practices and equipment (see www.equaladventure.org), but also in terms of inspiring the thinking about what really is meaningful inclusive practice for design and outdoor/expeditions.

12.3.6. Conclusion

Study 1 provides the framework for the research presented in this thesis, which aimed to produce effective postural support equipment for kayakers with spinal cord injury. It reflects on aspects of my previous fieldwork that was informed by information gathering and interpretation for the subsequent studies. Some key thematic needs emerged from this study.

Studies 3 to 8, results of which are provided in section 7.10. The researcher is not included in the sample number and the voice of the researcher is captured within a reflection in each study that is independent to the data provided by the respondents. The issues raised by the researcher and the respondents have been combined in this summary. Further details are available in the appendices.

Study 10 (n=2 for participants, n=1 for coaches) evaluated the practical and methodological product of the previous studies and research.

The ten studies completed reveal the successful involvement of spinal cord injured intermediate level sea kayak athletes in the research and development process. They show a development in methodology about how to plan, participate in and review research for the development of postural support equipment and kayak paddlesport opportunities for kayakers with SCI. By the conclusion of the studies, a successful postural support system had been created.

The format of each study affected the success of the involvement, or contribution to the development process, by the athletes with SCI. The format also had to consider how this balanced with the role/needs of the researcher and the aim of the study.

As the studies progressed, the effectiveness and accuracy of the research tools improved, culminating in the creation of a set of field-based data collection frameworks that balance input from the performer, designer, coach and therapy perspectives.

12.4. Study 2: AQUABAC – A Reflection of a UK Based Inclusive Design Proccess

12.4.1. Introduction

An overview of the AQUABAC is given in Chapter 3. The project was undertaken prior to this PhD research. It is hoped that this reflection will reveal added value and allow the lessons learnt in the previous pragmatic research to be used in this PhD research project.

An additional reason for this reflection is to help to draw a line under the AQUABAC project, to ensure that there is a clear delineation between PhD and non-PhD research. The reason for selecting the AQUABAC is because its focus is spinal cord injury and seating.

Again, I have used Greenaway's (1993) '4 E' method as a framework for my reflection; experience, express, examine and explore.

12.4.2. Aim

To gain learning from research on the AQUABAC undertaken prior to the commencement of my PhD research to provide more informed methods for the PhD research.

12.4.3. Experience

The AQUABAC project formed the major focus of my professional practice over a two year period. The project utilised focus group research and user testing to reveal the design criteria for an iterative design process. The focus groups took place at the Aspire Centre (RNOH), Stanmore, and the design took place at first at Brunel Institute of Bio-engineering before being completed at the Design for Life Centre, also at Brunel University. The project was undertaken in partnership with a national charity – Backup (the spinal injury charity), who promote the active rehabilitation of people with spinal cord injury following leaving hospital. The research was undertaken from the position of a staff member at a university.

12.4.4. Express

This was an exciting project and a very exciting time for me. I enjoyed the mix of the design and the coaching. It felt as though I was never off the boil. I was able to bring together all elements of the development process: equipment design, coaching, and development of community based opportunities for disabled people. I did however feel that I was having to skim over many issues including: biomechanics, physiology, and research methodologies.. I felt very comfortable with the user group, but as ever felt that the challenge was to record the process and persuade others of the importance of the work.

12.4.5. Examine

The research and development was successful as it led to a successful product and a number of design and achievement awards. The user involvement element made it possible to gather data, including the opinions and voices of people with spinal cord injury. This also led to the creation of a Kayaking club based at the Aspire Centre, RNOH, Stanmore.

The design work with the manufacturer was very successful. A product was created and design decisions were recorded in such a way that a full production dossier was created which led to the manufacture and sale of the AQUABAC.

12.4.6. Explore

In future I would take a more methodical approach to the gathering, to be able to gather data in an efficient manner in a live setting. I would also like to make more of the data or information gained to reveal more about the coaching of disabled athletes. I would make more of the coaching and design interface to ensure that there is a way of embedding the use of the new technology into the community, in order to make a larger social or educational impact. In retrospect I think that more community relations or publicity is required to ensure that the stake holders in the process understand the project processes.

12.4.7. Conclusion

Study 2 gives a reflection on the AQUABAC, a seating solution for novice canoeists and kayakers with spinal cord injury. The project utilised focus group research and user testing to reveal the design criteria for an iterative design process, work that was developed before the start of this PhD.

The research and development was successful and led to a number of design and achievement awards. The strength of the project was in its ability to involve so many users over the length of the iterative process.

The user group did not continue to canoe or kayak beyond the sessions provided during the research. There was an element of sports development missing. The marketing was poor, with none by the charity and that by the university mainly being publicity for the university. More needed to be made of the coaching and design interface and to ensure that there was a way of embedding the use of the new technology into the community.

It was concluded that while the project was very much led by design and external stakeholder requirements following an intuitive process, in future a more in-depth methodological approach would be needed. This could involve sports sciences, such as biomechanics and creating a better fit between research methods and creative design processes.

12.5. Study 3:Iceland 2001

12.5.1. Introduction

This study consists of a field trial in Iceland. The study is therefore presented as a formal field trial report, to provide context to the data gathered.

The field report is split into the following sections:

Aim

- Method
- Results:
- rafting
- sea kayaking
- Conclusions

Issues concerned with logistics and planning are given in **Error! Reference source not found.**.

12.5.2. Aim

To understand how to best use a field trial to research people-centred product design.

12.5.2.1. Method

The following were used to collect data: group reviews, participant observations and reflections (using the Greenaway '4 E method of experience, express, examine and explore).

12.5.3. Results - Iceland 2001

12.5.3.1. Part 1 – Rafting Day 1 - Rafting preparation

12.5.3.1.1. Aim

A dry land team warm up exercise to familiarise all participants with each other and both the standard and the adaptive equipment.

12.5.3.1.2. Leader's personal reflection

12.5.3.1.3. Experience

The team was split into groups. Each disabled team member worked with a coach or therapist alongside an observer. The aim of the session was to create a postural support solution which each disabled team member was happy to use during the proposed rafting the next day.

Each team member was asked if they were happy with their postural support. The session went well. AD and KD decided to use AQUABACS and DS has created a bespoke strapping mechanism which he feels happy to utilise tomorrow.

12.5.3.1.4. Express

This has been a good day. I feel as though the team has come together and there is a real common purpose. The session finished late and all felt that they had had enough following the international journey and would review later. This may have been an opportunity lost.

12.5.3.1.5. Examine

The process which they are going through seems to be very standard. There is a high level of technical input. My role, as facilitator, seems to be working.

The coach-centred group seems to be happy with the environment. The therapist- centred group seems to be happy with the clinical issues. The participants seem to be happy as long as they are treated as people.

12.5.3.1.6. Explore

I would like to experience what it is like to work directly with a participant or athlete. I would like to examine the relationship between therapist and participant, and coach and participant individually, rather than straddling two concurrent activities.

12.5.3.1.7. Group reflection following the first day's rafting:

12.5.3.1.8. NG – Coach and External Raft Guide

The morning with the ugly raft I learnt a lot, however the raft guide coached and did not guide. The afternoon – kit went well until after portage, when I had to start guiding. This caused a problem as I did not know the crew and it was a new team, new river to me on grade 5.

Jim, the raft guide got hurt and felt that his boss, Chris, was 'outside his box'. This was bad on the part of Arctic Rafting, as they should have had a back up plan without me.

Most people in the outdoors grab hold of a situation too tight when perhaps they need to let go a little more.

The swim was ugly! Had to think hard about the order of the rescue? It was probably about my perception of vulnerability of disabled rafters and the need to look after special needs.

Others in group need to assist with the rescue, but actually there is nothing different to standard practice.

My training put me onto automatic pilot, so all I need to do is challenge my perception of disabled people rather than follow my instinct to help.

Evac or rescue - split of group/safety kayakers: what are their operation procedures.

Lessons learnt: it was a harsh experience, but good it happened.

12.5.3.1.9. SP – Group Leader and Researcher

Whole trip - challenge to balance objectives with complex research activity, disability, protocols and issues. The early AM meeting was very useful and necessary. It set the scene for the rest of the day. Felt let down by the rafting company. I felt that there was some time pressure as it took time to refit equipment from yesterday.

In the boat that I was on the focus was on AD and KD. DR giving excellent support to AD and equipment. We wanted/asked for 'coached' session, but I had hoped that the rafting company would take a bit more appropriate control over the situation.

The morning session was good although I think that the raft guides stopped listening, this was not a good thing.

12.5.3.1.10. KD – Participant

I had issues with today and was concerned with my stability on such big water. I felt that I was not able to look after myself in the rive environment. This had an emotional and powerful reaction for me in terms of wanting to be independent.

Being carried and portage was OK. I understood the need not to do the hard drop. The tip out/swim was really challenging, although the buddy system worked. The equipment is working well, especially when it was simple and there was less faff..

During the evacuation and rescue I was distracted. There was lots happening, hard to prioritise/act, broke protocol in calling AD out of water.

- Didn't know Arctic Rafting procedure
- Once situation was clear, able to act
- Decision to paddle on hard, but right
- Sensed DR/SMC's different opinion
- Focus on recovery, getting everyone warm and safe
- Angry that team split once on land
- Pissed off with Arctic Rafting's commercial call

12.5.3.1.11. SMC - Outdoor Facilitator

Huge day on lots of levels – what to expect, a lot about observing; clear calls, decisions, leadership, coached boat, and lack of clarity.

It was a new experience being under the raft, tied to raft by paddles and throw line.

Should throw line have been hacked? The throw line attached around my BA!

Good to go and would do it again, it was a good day!

Key – communication in boat and decision making is what led to the call to come out of the eddy

12.5.3.1.12. CBW – Outdoor Coach

Too much too soon, however the large challenge brought out the best in people.

There were too many chiefs led to mild confusion, but the equipment was excellent, brilliant support and posture. We should remember that SP – part of the whole team.

With regard to equipment the combination of AQUABAC plus LITE KITE plus buoyancy aid adds up to a huge piece of kit.

DS under the water, not so good, we were just dropped into it, there was no progression from Arctic Rafting.

Coaching happened automatically, though we need more control over coaching and testing

More emphasis on rafting company needed

Very concerned about moving and handling of disabled participants on the expedition.

During the swim, did not want to leave DS. I know that DS felt I kept him together.

Worried about reaction to incident, I am keen to present human error, not kit failure. We needed to say ‘no’ to Arctic Rafting.

12.5.3.1.13. DR – Outdoor Facilitator

Good trip to Iceland flight and journey

Went downhill

The split site on our very first day did not contribute to getting KD and SP into groups. We need to generate a clear structure and we need greater river knowledge before we do this activity again. I don't want to get back into raft.

12.5.3.1.14. AS – Technician and Outdoor Novice

Too fast too soon, wanted to know about river features before we paddled them.

12.5.3.1.15. KD – Participant

Progression, we need to practise what to do in white water. There was too much time pressure from Arctic Rafting made things difficult for the whole group. I never felt happy with my seating position or contribution to the team. I needed to say "stop". There is too much equipment and straps on white water for me. Felt that the release released too quickly on the AQUABAC. I felt trussed up and had a lack of control in the bigger picture. I have concerns over getting into high grade water and concerns for the need for progression.

Surprised that it's not possible to get the equipment correct, even though this is a constructed environment. The small buoyancy aid made a lot of difference. I have more rotation. I want to try paddling with a torso strap. Integrating Lite Kite into dry suit would be good.

On a personal note, shocked at how I behaved in that situation. Felt out of control and did not open my eyes. I did not react and felt overwhelmed. I was shocked that I said "no", when asked "are you OK?"

Progression – does this generally happen in rafting? Rafting is for thrills. Is rafting commercially viable as an inclusive event? Is there a reasonable case for a joy ride?

12.5.3.1.16. CBW – Outdoor Coach

AQUABAC – base board with AQUABAC in a raft makes the raft handle differently. It changes the weight distribution of the raft. Would it be better to use the Aquabac in a rubber duck in this grade of white water with disabled?

12.5.3.1.17. RR - Therapist

Fantastic day, good instructions, good team interplay. I found it interesting to be a novice. Being washed away was humbling and cold, if I had been in control, there was nothing extra I would have done.

Is this not a high risk activity?

I am not happy that I needed help. We were cocky and perceived ourselves as rescuers, then to see later a couple of seconds planning would have made all the difference. We need to remember our limitations and did not communicate under stress.

12.5.3.1.18. AD - Participant

Quite well supported, the extra strap helped. Active padding is more comfortable with security of belt. During the morning I did not feel stable.

Question: Did you have sufficient input?

Answer: Did not have much input tying in, felt fine.

Morning I was concentrating on staying upright and centred around equipment – I did not trust it

Afternoon – more comfortable, so paddling went better; more powerful

Question: Are you achieving?

Answer: No, usual for camping.

12.5.3.1.19. DS - Participant

Over drop I was gobby

Relaxed too much, that's why it all went pear-shaped.

12.5.3.1.20. Post Group Review Reflection – Leader SP

These are thoughts on inclusive white water rafting and are based on reflection following a days rafting.

- Tying anyone into a raft will always present a higher risk than not tying someone into a raft.
- Raft guides need to be aware of the change in the dynamic or feel of the raft when there is a postural support tied in which is used by somebody who cannot 'high' or 'low' side.
- The changes in the characteristics of the raft are:
- Asymmetrical power production
- Increase in the height of the centre of gravity
- Decrease in the ability of the raft to edge
- Question: Group or paddling team management

12.5.3.2. Part 1 - Day 2 - Rafting Introduction to Day 2

12.5.3.2.1. Personal reflection (Leader / Researcher – SP)

White water rafting was organised by Arctic Rafting. The plan for the day was to undertake a single run on one of their standard class II rivers with a single drop that may involve portage. The day started well, with one raft running the drop and the raft with KD and AD in portaging. During the afternoon an incident occurred that changed the nature of the day and of the rest of the expedition.

12.5.3.2.2. Experience

Yesterday's preparation involved each disabled participant working with a coach or therapist to work out their personal postural support needs in rafting. This went well. AD and KD felt happy and decided to use the AQUABAC. DS worked with CBW and DR to create a piece of equipment that held him into the raft using straps.

Today was a single day raft trip on a grade 5 river. Two rafts with safety kayakers were on the river. The section of the river involved a portage around a large fall. One raft managed this without incident. The raft which had the two wheelchair users in did not attempt the fall and portaged safely.

A critical incident happened when one raft guide was damaged by unexpectedly bouncing out of the raft. He was not able to continue to raft the river. NG, one of the team, took over guiding under duress. During the following section we capsized and were being adequately dealt with by NG and safety kayakers. At this point the other raft, who were at the time safe in an eddy, decided to come to our rescue. During their frantic manoeuvring they also capsized. This resulted in an all-in scenario on a large, grade 5 arctic river.

A rescue and evacuation ensued. It was messy and in addition to the broken ribs of the raft guide, a minor fracture to a foot and a split lip were injuries which were also incurred by team members. Minor cases of hypothermia were treated in the local hot tub and swimming pool. Possibly the most critical element was

DS not being able to release his new strapping system, which he had set up inappropriately in haste when rushing to our aid.

12.5.3.2.3. Express

I felt angry with myself that I had let the team down. I was disappointed with the team from Icelandic Raft Guides, who I felt let us down technically and did not have a back-up raft guide. I took full responsibility for the incident, which knocked my confidence somewhat, and put me on my back foot with the team.

12.5.3.2.4. Examine

KD and AD were released from the AQUABAC. AD swam independently. KD and I swam together downstream, spending a few moments under water, during which time I pushed KD to the surface. NG managed to mount the upturned raft and pull everyone back into the raft, as described in any decent rafting guide manual. The other raft was not so fortunate and had team members strewn down an area of the river. DS had used his makeshift postural support that held him into the raft after the capsize. CBW deflated the raft with a knife to release DS.

12.5.3.2.5. Explore

Check the technical capacity of the providers. Create more staged experiences in the programme. Create a field trip which has a single activity focus, so that the equipment changes can be dealt with in a static environment.

12.5.3.2.6. What are the priorities?

Supporting or looking after disabled members of the team can distract from the cohesiveness of the paddling team

The amount of set-up time specific to the AQUABAC or any postural support system seems to detract from the time which the raft guide feels able to do skills coaching.

12.5.3.2.7. Thought

Rafting presents itself in the media as a dynamic ‘open’ challenge with a constantly changing environment. As a result the demands placed on the equipment are constantly changing. With this in mind it is worth considering how ‘open on the water adjustment’ is able to be achieved without changing the paddling dynamic of the raft, or breaking the serial rhythmical nature of the river experience. Therefore, the need is to ensure that any adjustment to a postural support system is immediately accessible to both user and assistant whilst on the move.

12.5.3.2.8. Foot entrapment and footwear on the river

The combination of water and rocks can and does cause harm to the feet and lower extremities of disabled rafters. For rafters with little or no sensation in the lower limbs there is a need to provide a protection to skin structures and joints for the exposed areas. Entrapment of disabled rafters’ feet seems also to be a greater risk.

12.5.3.2.9. River lines

Concern was shown for the folding action of the raft on a river, as team members who are not able to move their feet may have found their feet trapped in the gutters of the raft, between the tube and the self bailing floor. This led to two critical decisions:

- To place the disabled (AQUABAC users) in the middle of the raft, which is less likely to fold.

- To take a line on the river that is less likely to make the raft fold. This may reduce the high fun or adrenaline aspect for which rafting is known.

12.5.3.2.10. Notes for fitting the AQUABAC to a raft

- Choice of D rings

- Must leave a low profile in the raft, so use patches with fabric loops only, ie no D rings

- Placement of D rings or attachment pads

- The aim must be to create as little displacement or interference to other rafters as possible. Avoid creating a hazard for snagging either the AQUABAC user or other rafters. Provide tension that pulls the base board down onto the tube, as well as providing horizontal locating forces.

12.5.3.2.11. Rescue priorities

On debriefing, most of the guides felt their priorities had been changed as a result of the involvement of disabled paddlers or rafters in the incident. They suggested they had rearranged their priorities and felt that the nature of the rescue would have been different if the incident had involved a completely non-disabled crew.

Rescue priorities are set to preserve life, minimise further harm, and reduce risk to both rescuer and swimmer. All priorities remain the same regardless of disability. Therefore, if the equipment works, what else needs to be done to ensure that the inclusive event runs smoothly using standard protocols? Is it choice of environment, training the team about the individual and specific equipment? Question: were judgement calls changed by the unique nature of inclusive rafting?

12.5.3.2.12. Moving and handling - inspired by conversation with CBW

Rafting as a sport places large forces on the body. Consideration needs to be given to moving and handling of the raft, especially when some members of the team may not be able to help.

12.5.3.2.13. Note

On debrief the helpers in the team, ie CBW, SMC, RR, AS and NG, all felt that the project had been hard on backs so far.

Table 39 Pictures of Rafting using the AQUABAC, Iceland

12.5.3.2.14. Phase Conclusion

The key factors which have been revealed during the phase are:

- Technical issues concerning the adaptation of rafts to include disabled and non-disabled people.

- There are obvious variations in approach to the task of adapting equipment between coach and therapist.

- Attitudes towards risk and disability seem to be skewed, especially by those with little or no experience of being on water with disabled people.

- It was good to use reviewing in a group setting. It diffused the fall-out from the critical incident.

12.5.3.2.15. Change of Plan due to the critical incident

As a result of the lack of regard of the rafting company and the overall experience of the day's rafting, the team decided to take a day's rest and travel to the sea kayaking venue.

12.5.3.3. Part 2 – Sea Kayaking

The following section takes place at the pre-arranged sea kayaking venue and is separated in time from the rafting study by 24- 36 hours. The team re-formed and seemed in good spirits.

12.5.3.3.1. Sea kayak briefing–experienced sea kayak coach

The briefing covered the following topics:

- stability in relation to orientation to the waves
- discussion about adaptive rescues - possibilities included getting people over the stern and conveyor belt rescue
- rescue issues – increased need for stability and increased time taken for rescue
- thoughts on when to use flares in Iceland and operational distance from shore given the average 1.8km horizon on a clear day when seated in a kayak.

Kit list: Day Sea Kayaking	
Chocolate	Sun Cream
BA	Shades
Dry clothes	Hat

Kit list: Day Sea Kayaking	
Tow line	Whistle
Med kit	Cooking gear
Fishing line	Camera
Split paddles	Bivi or basher
Map, compass/chart	Water
Water sack	
Flares - smoke and point	
Spare deck	

12.5.3.3.2. What extra kit to take to make this inclusive?

Results from whole group discussion

Something to sit on	Long sling
Padding	Extra warm stuff
Rolling aid	

12.5.3.3.3. Day 1 Sea Kayaking - Sea kayak equipment fitting and coach/performer relationship

12.5.3.3.4. Venue:

The following sessions happened at a campsite near the sea with access to accessible showers and a reasonably accessible beach. Group activities were undertaken on a flat area outside a Nissan hut kayak store overlooking a sheltered cove or beach. The name of the venue was Hammersvick.

12.5.3.3.5. Aim

To look at the coach/performer relationship in terms of the approach that a coach might take to make it possible for a kayaker with SIC to participate at an intermediate level.

12.5.3.3.6. Method

The team were split into three groups. Each group had a performer, coach and observer. The role of the performer was to improve their ability to sea kayak. The role of the coach was to facilitate the improvement. The role of the observer was to note the process.

Performer	**Coach**	**Observer**
KD	CBW	DR
DS	SM/SP	AS
AD	NG	RR

Note: Suresh – floating observer

12.5.3.3.7. Group leader SMC – Notes from Team

- Choose a boat in consultation with coach, individual and supplier.
- Discussed biomechanics of paddling, balance etc/needs
- Balanced individual's physical skills and requirements with biomechanics and choice of boat
- Considered 1) abdominal support, 2) lumbar support, 3) foot separation/boat balance

- Front pad is to prevent forward flexion beyond range of control.

Uncontrolled flexion may result from forward strokes

- Back pad to provide comfort and prevent extension beyond range of control

in backward strokes

- Central divider/abductor
- Design of equipment
- Considered the following factors; materials used, strap requirements/points,

qualities, frictions of tapes, stiffness, release/safety, kinds of buckles, pressure

12.5.3.3.8. Group Leader DR – Notes from Team:

We undertook the exercise in two sessions.

Session one included:

- Introductions
- Quizzing
- coach experience of organisation
- -coaching and provider philosophy
- Open forum to discuss aim
- History – trauma, background
- personal domestic issues
- functional terms

- discussion followed that related function and performance
- performer – previous experience, ie what you have tried
- Personal adaptive equipment
- Detailed aims and objectives of session
- Forwards, backwards etc
- Safety issues
- Intro – goals and alterations
- Standard operating procedures

Session 2 – this was more involved with the activity.

- Kit explanation - form and function
- Which is the most stable kayak – client concerns
- Access transferring into sea kayak
- Reduce equipment to fewer selection and get the performer to decide that they own the opportunity and the equipment
- Skin care/personal issues, sensation in a human sensitive way
- What are the safety issues, security
- Water confidence – how to define it and are we all at the same place
- Listening all the time.

12.5.3.3.9. RR Therapist Leader – Notes from Team

Sea kayaking fitting session with AD – spinal injury T10

Discussed choosing a boat – height of cockpit, rudder eg if there are strings are attached that get in the way

Abdominal support – would like support all the way round at belly button level. T10 injured person would like support to T12 to allow unrestricted abdominal movement.

Foot pedals – ensure strings not in the way.

Balance – block between knees/ankles to keep feet on separate sides of the boat. The central support should be without gap, to ensure feet do not get stuck. NB, for forward paddling a front support is more important.

Kayak control comes from; blade, boat (pushing on foot rest), body (trim for forward/backward paddling, balance, tilt of the boat, lean of the body)

The most easily achieved elements of control is are from lean and trim.

The discussion process has been discussed at expert level, with AD taking the lead.

Posture –

A – appropriate

B – basic

C – comfortable

D – dynamic

E – effective

F – flexible

12.5.3.3.10. Equipment Design Options –

Lateral support with foam wedges

AD ha previously used fiberglass corset which releases from the boat, with a foam pillar in the centre

Seated in regular cockpit with a gel pad wedging and foam pad behind to provide lumbar support

Back wedge blocks 2 inches above cockpit rim to enable hyperextension backwards, lateral support at the same level is required

Abdominal support needs to have quick release buckles

Gel pad needs to be carefully positioned for skin condition protection

Foot protection includes wearing wetsuit boots

Transfer pressure protection for getting in/out the boat

Release buckles in an abdominal support need to be considered

Rubbing factor of tape on performer's legs etc

Issues with fitting tape to the abdominal support; it needs to be far enough back in the boat to offer the right amount of support while allowing the ability to lean forward during strokes.

12.5.3.3.11. NG Leader – Team Notes

Standard coaching process

Inquisitive about their experience and their performance

Want to know what function

Discussed basic skills and safety

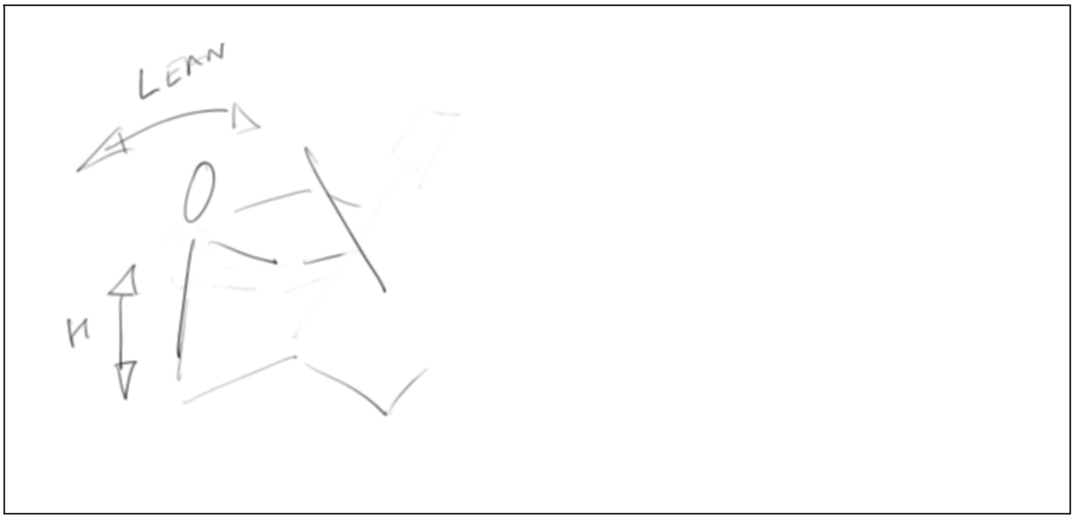


Figure 50 Diagram Reproduced from Team Notes

12.5.3.3.12. Day 1 - Group debrief from kayak fitting session

The following section records the notes from a group discussion based on the experiences gained from the sea kayaking fitting session.

12.5.3.3.13. CBW - Coach

I was comfortable with the exercise, it made me think a lot about my coaching method, especially the order/method of approach. It is hard to role play, i.e. set out an order/content for initial session.

12.5.3.3.14. DR – Observer and Note Taker

Our process led to a group chat. I felt that we were all equal participant and coach. I feel fine with the process, although this exercise has gone beyond centre activities, especially in terms of the depth of questions and the expectations of the participant.

If we were doing this on the water it would be faster to demonstrate initial session and how that may lead on to the performer.

12.5.3.3.15. AS - Observer

Successful – brought out good points, swapped roles and went into design mode – happy with that, as I am really a designer.

12.5.3.3.16. DS - Client Perspective

The exercise felt good, communication became key again I needed additional support to understand the process. I felt involved and part of decision making process.

12.5.3.3.17. NG - Coach/Helper Perspective

Sea kayaking is not initial session, so it all felt uncomfortable. Straight intermediate performer rather than a beginner we should look at this from the perspective of getting a beginner into a boat.

12.5.3.3.18. RR - Varying Perspective

Initially observer. I wrote a lot, then with AD took on role as expert. We then got into a more practical discussion. Then felt redundant - unusual as I am usually the bolshy one.

12.5.3.3.19. SMC - Coach Perspective

I acted as the coach, talking to DS. The things that I thought about were; 1) How should the process happen? 2) What is the nature of the questions? 3) Challenge to apply?

I found that it was hard to be proactive. At first it felt false, but then the format became evident. So I stopped and then looked at standard kit. Then the process became evident. On the whole I felt uncomfortable in taking the lead role on this trip.

12.5.3.3.20. AD - Athlete Perspective

Clear about what I wanted to achieve but not sure how to get there it became problem solving, the session provided ideas for equipment.

I was happy with NG (Coach) taking control because it is sometimes difficult to see what you need. In general I am happy with someone else taking control as long as we listened too.

12.5.3.3.21. KD - Client Perspective

The session plummeted into equipment following details. Felt great – one to one with a good two-way process. We established confidence before getting kit out. I think that in real life we would have been down on water.

I hate designing. I do not like playing with kit, which is why I have only ever paddled with a small piece of foam and a piece of gel.

12.5.3.3.22. Development Process

The following group exercise followed a short sea kayaking session and was undertaken on dry land in good weather in a beach setting at the sea kayak venue. The question set to the group was:

'Process – What process did you use to try to discover or exchange information concerned with assessing coaching and equipment requirements'.

The understanding of the task was checked with each group and each group made a presentation of their process , with the group process taking approximately one hour.

12.5.3.3.23. RR - Therapist

The creation of a process and a checklist seemed to be a good place to start. We considered the following characteristics for the individual;

- Pressure
- Balance
- Sensitivity
- Mobility
- Transfers
- Brace
- Grip
- Paddle
- Arm strength
- Co-ordination

12.5.3.3.24. Designers

- Aim and objective
- Plan of actions

- Check on change of group dynamic
- Brief
- Brainstorm
- Creation

12.5.3.3.25. SMC – Therapist

- Names
- Reasons for being here – no previous watersports, but seen sea kayaking on TV
- Swimmer
- Hobbies exchanged
- Honest with coach's experience (each explains what they have done before/experience etc)
- Health issues exchanged, medication required, DS openly explains what happened to acquire his injury
- What else do you do with your time – not do you work
- Expression of problems staying in the boat on one previous experience when single paddle used, has never used double ended paddle, rotational ability described
- Discussion regarding stability of upper body control. DS says he is concerned about stability and Sinead explains that we will get him comfortable

first before then working on techniques to help his stability on the water, we will have some fun!

- Safety cover mentioned (discussion about safety cover first followed by fun)

12.5.3.3.26. NG – Coach

- Moving and handling/access to the performance environment.
- How do you do that i.e gain access?
- What is safe, controlled and good practice?
- Compromising delicate situation i.e. reaching between the legs
- Consider general equipment
- What do I need to do to get this boat to a stage where we can quickly sort out a rig for the individual?
- Body – bias to posture
- Coach – learning to react to their paddle practice with the performers
- If I do this, how will this affect you?
- KD view of a good piece of equipment is such that it would not protrude over the top of the cockpit, therefore the coach should ask the performer what their ideal bit of kit would be?
- Transition from torque to planning to action

- Key issues – access, transferring, body space, communication with equipment, developing a functional process of sport to fit a functional profile of performer.

12.5.3.3.27. Amalgamated Checklist

An in the field graphical mapping of the issues was undertaken, as represented in Figure 51 Checklist Mapping.

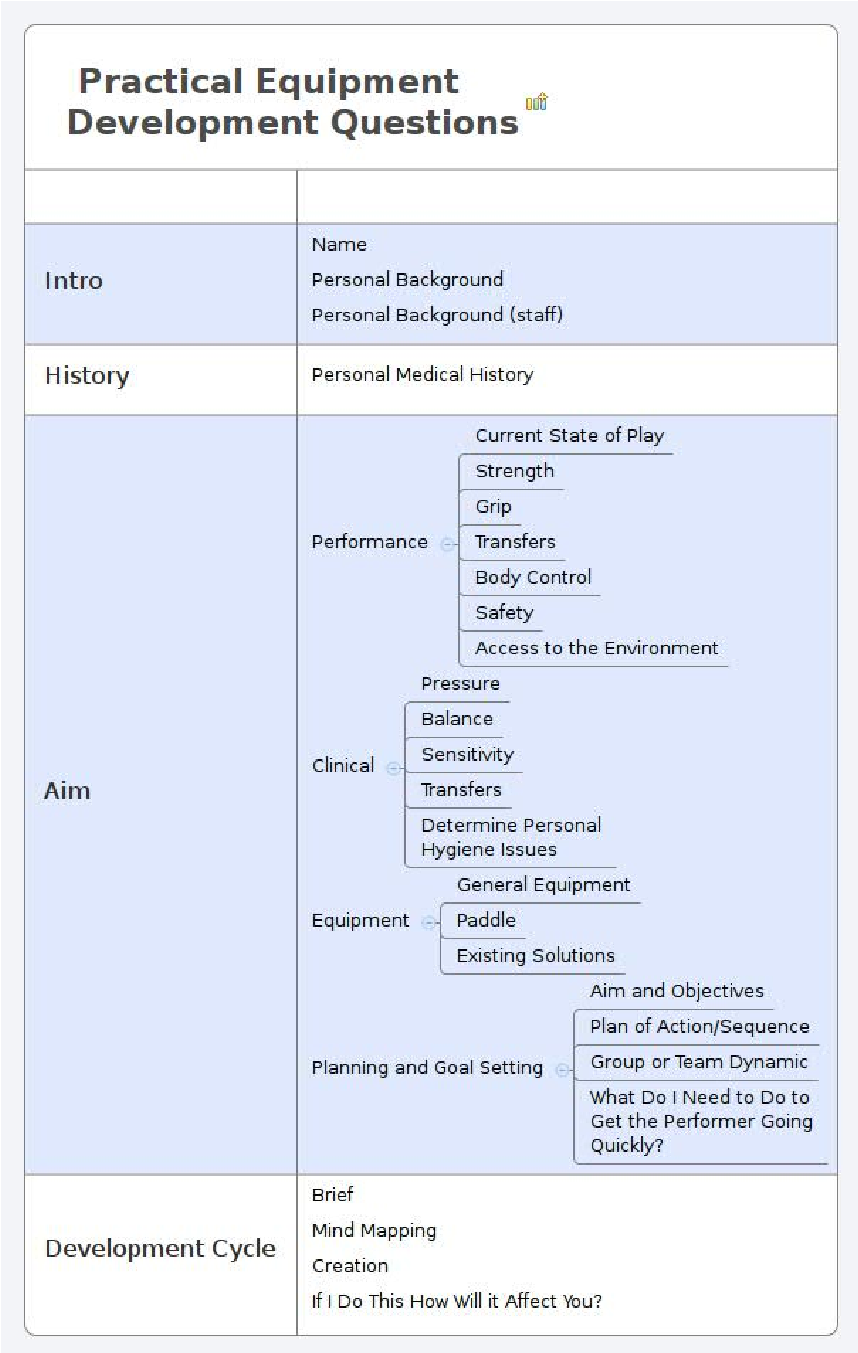


Figure 51 Checklist Mapping

A detailed review of the key themes revealed the following amalgamated check list

- Intro

- Names
- Motivation
- Personal Background (Performer)
- Personal Background (Staff)
- History
- How do you currently gain access?
- Performance
- Current State of Play
- Personal Medical History
- Co-ordination
- Strength
- Grip
- Transfers
- Body Control
- Clinical
- Pressure
- Balance
- Sensitivity

- Mobility
- Transfers
- Delicate personal or personal hygiene issues
- Personal Performance History
- Of the activity
- Other Activity
- Safety
- Equipment
- Existing Solutions
- Paddle
- General Equipment
- Planning and Goal Setting
- Aim and Objectives
- Plan of Action/Sequence
- Group or team dynamic
- What do I need to get the performer going quickly
- Development Cycle
- Brief

- Brainstorm
- Describe your ideal piece of equipment for this situation
- Creation
- If I do this how will it affect you?

12.5.4. Personal reflection on sea kayak sessions

12.5.4.1. Overall Reflection

12.5.4.1.1. Experience

Briefing for a series of sea kayaking experiences was given by an experienced sea kayak coach in the team. Discussions between coach, sea kayak expert and me (as designer or researcher) revealed that one of the key tasks for the designer is to reduce the task complexity for the participants.

Fitting – a series of short fitting or briefing sessions then took place. Each group consisted of a coach, participant and observer. I placed myself as an observer to the whole process.

Practical – this was much more staged than the rafting and started with short ‘float sessions’ in the bay and was followed by a journey. The programme of the days was interrupted by individuals trying to come to terms with daylight, or at least the lack of night.

12.5.4.1.2. Express

This part of the project felt satisfying and very positive. I would have loved to do more iterations of it. Working with such highly motivated issues means that there is a constant pressure to provide access. It can feel quite compelling. This makes it hard to maintain clarity or say “no”. It has sometimes seemed to be a challenge to undertake staged research, when all the participants really want is just to paddle, ie they just want the end result.

12.5.4.1.3. Examine

12.5.4.1.4. Briefing:

This really helped to bring the team together. I think that the rafting, despite the incident, was a great warm up. It was a shame that some bad judgement calls were not challenged.

The individual teams were all successful. The way in which they recorded their outcomes or process depended greatly on their personal learning styles as well as their personality. The notes they handed to me following the sessions varied greatly in clarity and depth.

12.5.4.1.5. Practical:

The key issues became about kayaking, getting all of the team afloat together. The daylight again messed up people's routines, so issues concerned with access to water or hot meals were where the conflict happened.

12.5.4.1.6. Explore

This stage revealed the need for a range of competencies: coaching, technical, planning and environmental issues concerned with getting the whole team together and comfortable in the right place seem to be paramount. Environmental access is a continual challenge. It would be helpful to provide a clear brief on note writing, to ensure that participants provide the level of depth required.

12.5.4.2. Post Iceland reflection

12.5.4.2.1. Experience

The advance team managed to get all of the equipment and supplies to Iceland by ferry using one of the team member's cars. Equipment was packed into barrels and food for all of the team purchased in Scotland prior to departure. This was a success. The main team arrived by flight and travelled a considerable distance by bus to the first site. The team arrived, but the site selected required disabled members of the team to travel 600metres to an accessible toilet. Additionally, the cooking facilities were not accessible. These difficulties were overcome, but the following day the team as a whole moved to a more accessible venue. Two days' rafting were supported by Arctic Rafting, an Icelandic rafting company. The fitting session went well. Equipment was either used or created to allow all participants to paddle actively in a raft. Over-zealous raft guides, perhaps combined with rising river levels as a result of an unexpected heat wave and a lack of experience by the leader in white water rafting led to a critical incident. Minor injuries were incurred and the team lost momentum. A critical incident debrief followed, which revealed individual stories and allowed the team to move on. The sea kayaking section was then focused on rather than continuing with white water rafting. Planning, preparation, short trials, followed by an extended journey, created a forum for the discussion of methods concerned with the development of equipment and coaching techniques. The accessible site and accessible hot tub proved to be a great success with the team.

12.5.4.2.2. Express

Despite the really challenging elements during the critical incident the project felt like a success. I do however leave this fieldwork with a sense that in no small way I was responsible for what happened. This has shaken my confidence in my ability to lead in the field. I also feel that I need to be able to express my research in a simpler format so that it is more accessible to others. I felt that although the project was a success, I struggled to make myself understood. I do however have to remember that I deliberately placed myself on the outside, as an observer.

12.5.4.2.3. Examine

The project allowed for key themes to be explored, in terms of the development of inclusive opportunities. From a design perspective, it is clear that there is a need to create a piece of equipment which is simple and minimizes the cognitive load placed on the individual. From a coaching perspective, there was a lot of informal discussion about why other coaches and outdoor facilitators find the process of adaptation or the creation of accessible opportunities so difficult. The inter-disciplinary team gelled, and got on really well.

12.5.4.2.4. Explore

In future I will focus my attention solely on the design and development element to the research. I feel that the exploration of coaching at this time is beyond the scope of this research, as it becomes too complex to explore the intricacies of coaching with the coaches, the product with the participants, while also being a clinical observer to the whole process.

12.5.4.2.5. Ramblings

Informal discussions between SP, DR and CBW re the advantages and disadvantages of international expeditions as research:

Advantages	**Disadvantages**
Provide a carrot to entice appropriate and suitably experienced participants to be involved Fun, holiday/cultural elements for participants; Costs can be managed Provides an opportunity for newsworthy stories Provides an opportunity for the generation of positive images of disabled people participating in an unique environment Presents access to host nation International comparison of access issues Presents inclusion in outdoor adventure to the international community Hot tubs	Increased cost? Increased complexity of logistics Increased complexity/uncertainty of research environment Increased time required for similar output Uncertainty about access Can be challenging to find appropriate group space Increased distractions from research More complex risk assessment Dried food gets boring

Advantages	Disadvantages
Offer wider range of environments Example risk assessment for others to follow	

12.5.4.3. Informal discussion between coach, designer, researcher

- As individual performers become more involved in the sport, they are willing to put up with more complex equipment

- An increase in challenge often requires an increase in the level of equipment complexity

- Increase in complexity places higher demands on both coach and performer, requiring them to exchange more information more accurately, therefore planning and goal setting and communication must be a higher priority

12.5.4.4. Conclusion

Study 3 provides a report from a field trial in Iceland that aimed to inform the development of equipment and information for inclusive adventure sport. Group reviews, participant observations and reflections were utilised for data collection. This was my first experience of person-centred field research with a research objective central to its aim. The project used reviews from spinally injured participants, coaches, therapists, facilitators and the researcher to review coaching processes and adaptive paddling techniques for paddlers with lower limb disabilities in white water and sea kayaks.

Reviewing was a good methodology for information gathering in a group setting. It revealed differences in approach between coaches and therapists, interview criteria which combined coaching and therapeutic standpoints, as well as a skew in attitude toward risk and disability, particularly by those with little or no experience of being on water with disabled people. Technical issues were revealed concerning the adaptation of white water rafts to include disabled and non-disabled people, including a checklist for seating and a list of additional standard equipment for use by an inclusive sea kayak coach.

12.6. Study 4 Questionnaires and interviews with disabled sea kayakers: - Aberdeen 2002

12.6.1. Aim

The aim of the study was to explore practical equipment issues, aspirations, and current understanding and practice with three lead user kayakers with spinal cord injury.

12.6.2. Setting

The questionnaires were completed indoors, while the semi-structured interviews took place face-to-face with the participants on a dockside.

12.6.3. Method

Each participant was initially briefed to inform them that they were participating in a questionnaire to assist with research. Each participant was set up in an individual and quiet environment. They all stated that they were comfortable with their environment before the questionnaire was started.

Semi-structured interviews were carried out the day after they had completed their questionnaires, to find out more about their perception of adaptive sea kayak techniques. One participant was unable to stay for this part of the research.

The semi-structured interviews were undertaken directly after both participants had returned to shore and changed their clothes following an evening's two-hour session in coastal waters, in sheltered, calm conditions, in North East Scotland.

Interviews were undertaken separately and notes were recorded as jottings, which were then written up into field notes to create this record.

12.6.4. Questionnaires

The data from the questionnaires is summarised in the table below: Table 40 Data Collated from Questionnaires

Table 40 Data Collated from Questionnaires

Questions	MK	AD	KD
1. How would you describe the nature of your disability/function?	L1-3 Spinal cord injury following a fall whilst climbing. I am complete at L1 although L2, 3 are also compressed	Complete spinal cord injury with some upper tummy muscles, following an incident climbing. Level - can't feel below belly button.	Complete Spinal cord njury at T3-4. Wheelchair user. I fell climbing on sea cliffs.
2. Please describe your experiences of kayaking	Wobbling around in the boat and not being able to brace my legs on the side of the kayak cockpit. I have more experience in a canoe than in a kayak	I am happy on the river and use a kendo with a very rigid brace that goes around my waist at the level above my injury. I am able to roll my river boat and able to do a bit of competing in Rodeo	I use a double sea kayak and sit in the front of the kayak. Sometimes I feel like a passenger. I make do with a just a gel pad and a foam support.
3. At the moment where would you consider yourself to be on the performance	Novice – Intermediate	Intermediate on river Novice – Intermediate on sea	Novice – Intermediate

Questions	MK	AD	KD
continuum?			
4. What would you define as good performance in kayaking?	Just being able to do it	Independence, being able to teach	Independence
5. Where would you like to be in terms of your performance?	Advanced paddler in two years time	Being able to do what I do on the rivers on the sea – be a level 3 sea kayak coach	Independent paddler
6. Can you describe some of the key features you would like to see in an ideal piece of kit?	I would like something that I can move from one boat to the next	Need something that gives me control of the boat	I want to be able to paddle solo and improve my ability to control the kayak
7a. Are there any words you would use to describe the nature of the equipment?	Simple Versatile Durable Comfortable	Simple Support Control Able to roll	Simple Transportable Effective Easy to use
7b. Can you put these in	1. Simple	1. Able to roll	1. Easy to use

Questions	MK	AD	KD
order of priority?	2. Versatile 3. Durable 4. Comfortable	2. Control 3. Simple 4. Support	2. Simple 3. Effective 4. Transportable
8. What sorts of things happen at the moment when you are kayaking which you would like to change?	I would like to make it possible to control the amount of flexion in my legs to help me locate myself in the boat At best I am only able to achieve a sloppy interface between me and the boat	Able to do the same things I do on the river in a sea kayak	I slump in my kayak I have to paddle with someone else.
9. Are there any specific activities in kayaking which you feel you cannot achieve without equipment?	Staying in the boat, boat control and direction	I find it difficult to paddle slowly and get back into the boat on my own without assistance.	Rolling and support strokes
10. What do you think that you need?	I don't think that I need postural support so much as a piece of equipment which	I need something that will allow me to paddle solo and is able to give me the	I need a postural support that helps me control the boat and make more powerful

Questions	MK	AD	KD
	is able to secure me in the boat	control that I have in a river boat in a sea kayak	strokes. I need a cushion or gel to sit on.
11. What are the specific safety issues you feel are important to the design of the equipment?	A. Exiting the boat when required B. Position and posture which is comfortable and sustainable as well as being non-damaging C. Ensuring that I don't damage the skin on my legs and feet as well as on my bum, basically the areas that I do not feel	A. Exiting the boat following a capsize B. Being able to roll C. Being able to paddle well	A. Being able to get back in the boat following a rescue B. Being able to roll C. Being able to get out of the kayak
12. Can you put these in priority order?	A B C	C B A	C B A
13. What is your understanding of good kayaking posture?	Very little	Not much	Sitting up straight Being able to do things

Questions	**MK**	**AD**	**KD**
			Having no pain in my shoulders
14. If you were going to buy something to help you perform more effectively in kayaking how much would you pay?	£150	£200	As little as possible
15. Do you know what specific boat makes and models you would like to use the system in?	No – not specific makes just something which will do a range of situations for me.	Romany Explorer from Nigel Dennis	Capella double sea kayak Perhaps Aleout Expedition Double

12.6.5. Reflection from questionnaires

12.6.6. Introduction

The reflection follows the 'Four E' method presented by Greenaway (1999).

12.6.7. Experience

I was able to conduct three separate interviews face-to-face. The interviews took place indoors with access to a sea kayak. A pen and paper were supplied to the participants to allow them to add additional comments. Many of the themes for interviews came from my experiences in Iceland. Each interview took approximately thirty minutes.

12.6.8. Express

The participants felt quite impatient. Their need is for immediate action. I feel that they want to have something to test already. It is like the research process is an inconvenience.

12.6.9. Examine

This study has given me a list of practical wants for a postural support system. The emphasis on independence seems to be quite important. The ultimate goals seems to be independence.

12.6.9.1.1. Summary of results

All participants have had a traumatic injury whilst climbing.

Their kayaking experience ranges vary from very little (at a novice level), to being independent once postural support is provided (at an intermediate level). They would like in future to either participate without lots of complication, become independent, or become sufficiently independent to be able to teach. All would like to improve their performance by at least one level.

The participants showed little understanding of kayaking posture, so this may well have influenced the lack of mention of this in their answers to questions about requirements from any assistive equipment. It also suggests that equipment is only of use if there is an associated training around the skills required to kayak.

The participants prioritised portability and the gain of boat control as being key features of any kit.

They also used wanted equipment to be simple, versatile, durable, comfortable and effective, with simple being in everyone's top three priority list.

The equipment needs to enable them to be secure in the boat, to paddle solo and move powerfully. This means it needs to provide control where there is a loss of control as a result of their injury, namely in the legs and torso.

Their current experience has shown they have difficulty with staying in the boat and gaining control for different speeds, strokes and rolling.

They all recognised the importance of being able to exit the boat should a capsize occur. The more experienced kayakers also wanted equipment that would enable them to be able to roll. The less experienced kayaker was more concerned with comfort than with performance.

The participants were willing to pay up to £200 for equipment that would improve their performance. Although they stated the specific boat models in which they would like to use the equipment, it may be that their limited opportunity to access kayaking restricted their answers and that any equipment should be transferable to any kayak.

12.6.10. Explore

I need to consider what the limit is for intermediate paddling. My own experience specific to sea kayaking needs to improve so that I can better understand the parametres of intermediate paddling. Although I am an experienced canoeist, I recognise there are important differences between canoeing and kayaking, but need to investigate these differences further. I also need to investigate what differences there may be to intermediate kayak paddling for non-disabled participants compared to those with a spinal cord injury.

I need to explore what happens to the participants when they are kayaking. I have recognised that considering equipment in exclusion to coaching and active participation does not provide for full information. In future, research relating to equipment needs to be undertaken in a fieldwork setting, so that participation and coaching can also be addressed.

12.6.11. Semi-structured interviews

12.6.12. Introduction

The following study uses data gathered from two lead users with spinal cord injury, KD and AD.

The aim of the semi-structured interviews was to further understand the nature of the current adaptive paddling techniques employed by the kayakers when using their existing ad hoc postural supports.

The strokes evaluated were chosen from the BCU Star Awards Scheme. A short list was selected in order to gather data on their experience of strokes from each quarter of the kayak, i.e. front, mid and back deck, as illustrated by Morris (2005).

The strokes were; forward paddling, stopping (hard reverse paddling over short distance), forward sweep to move the boat away from the paddle side, draw stroke to bring the boat closer to the paddle side, stern rudder – a steering stroke applied at the back of the boat.

The kayakers were asked to explain their experiences of undertaking a stroke, based on pointing the kayak into the wind and perpendicular to any waves.

12.6.13. Data

KD – female, no feeling from the chest down

Forward paddle – I find that I am quite effective with this. I throw my hips forwards in rough weather and lean back a bit more so that I have more to pull at. Having said that, any side to side motion can be a bit tricky to deal with.

Stop – I lean back big time in my current postural support, so find this OK, especially if I am in a double.

Rudder – I find it difficult to reach behind me when this is combined with reaching to the side. As a result I use a double sea kayak and sit in the front, with the person at the back attending to the steering using a rudder.

Draw stroke – I find this a difficult stroke, as I have no tilt or trunk rotation

AD – male, no feeling below belly button

Forward paddle – I use funny arm movements to compensate for my lack of control.

Stop – I find this easy but sometimes throw in the odd low brace to add a bit of support.

Rudder – Again I use this in my river boat quite effectively, but sometimes have difficulty leaning back against the rigid glass fibre hoop. I adapt this stroke by torquing or cranking, which is moving my hands from the symmetrical position down to one paddle so that I get a longer reach.

Draw stroke – I find this OK in my river boat, as I have a rigid hoop of glass fibre which holds me tight into the boat. I find this an easier stroke to do on the move, i.e. I use a hanging draw more easily than a static draw, as it is a bit more dynamic and I get a constant pressure on the blade. It is useful to gain support from the blade while it is in water.

12.6.14. Reflection from semi-structured interviews

12.6.15. Introduction

The reflection follows the 'Four E' method presented by Greenaway (1999).

12.6.16. Experience

The interviews were undertaken directly following the involvement of the two participants in a sea kayaking session. They took place on the dockside, a setting in which both participants said they felt comfortable. The participants were interviewed separately, one after the other.

12.6.17. Express

This study revealed some valuable insights into adaptive sea kayaking techniques. I feel that as a designer there is a need to understand the broader context, to ensure that the equipment is not over designed. I do not feel that I was able to see a full range of environments.

I noticed that having had a chance to successfully participate in some sea kayaking activity, the participants seemed more willing and able to engage with the questioning process. The study seemed to have more meaning to them as a result of this. I felt this was the more successful part of the whole study, when compared with the questionnaires, as their answers seemed to be more insightful.

12.6.18. Examine

Only two participants were able to attend this part of the research. The data would possibly be more meaningful with a larger number of subjects. However, getting participants who have a similar injury, skill level in a sea kayak and comfort with the outdoor research environment remains a challenge.

The four strokes selected were sufficient to gather information.

Sitting angle seems to have an adverse effect on trunk rotation and trunk rotation seems to have a direct effect on the ability of the performer to create powerful strokes without disturbing the tracking of the boat.

12.6.19. Explore

In future, I would like to carry out a similar piece of research in a range of different environments. I would also like to engage a larger number of participants in the research.

Any questionnaires that I choose to use will be given to participants only immediately following some active, meaningful participation in the activity being researched.

Once information has been gained, it is helpful to immediately make alterations to equipment and re-test during the same session. This will make the most of the opportunity, while the participants and environment are available.

12.6.20. Conclusion

Study 4 gives a reflection from the use of questionnaires and semi-structured interviews to reveal information about equipment and aspirations of three lead user spinally injured sea kayakers.

All the participants aspired to improve their performance and to be able to participate independently. They wanted equipment that prioritised portability and an increase in kayaking control, including the ability to roll, and were concerned about the balance between security and exit as a result of a capsize. The participants wanted equipment for use in a range of craft for use in sea and river kayaks, at an optimal price of no more than £200.

The participants were found to have little knowledge about posture and its impact upon performance in a kayak, suggesting the need for further education of the participants before they can have further input into the design process.

The study reflection revealed the need to provide participants with immediate design interventions while they are on the water, as lengthy interventions interrupt their kayaking session. This can present a challenge to the researcher, whose main aim is ultimately to create the most robust solutions, with time-frames and participant experience within the design process being secondary. However, participation in meaningful activity helps to calm the participants and they are therefore then able to provide more meaningful data.

There is a need to gain further understanding in a range of different sea states or conditions. This study may also have been limited by the relatively small sample size.

Figure 52 Stonehaven Harbour – the location for the evening Kayak

12.7. Study 5 Observation of Top Level Coach – Coaching Sea Kayak on Inland Flat Water

12.7.1. Aim

To identify the techniques used by a coach when trying to understand the needs of disabled athletes in a sea kayak.

12.7.2. Introduction

This study used participant observation to reveal methods utilised by high level coaches when working with disabled athletes in kayaking.

It followed study 4, which revealed the importance of questioning and goal setting in creating meaningful performance.

Greenaway's '4E method' was used as a framework for personal reflections; experience, express, examine and explore.

12.7.3. Setting

The study took place on flat water on an inland loch, at Loch Morlich with DC, a Level 5 Coach (British Canoe Union) and Head of Canoeing at Glenmore Lodge National Mountain Centre.

There was a light onshore breeze and there was good visibility.

12.7.4. Method

Data was collected by jotting in a waterproof notebook at the time of the participant observations. These were then written up in detail and typed to form a permanent record of events.

The observation was completed in one session. The session lasted approximately three hours; one hour for preparation, one hour on the water and one hour for debrief, pack up and 'thank you’s'.

The preparation consisted of carrying the boat from land to the water shoreline, to help the participant gain access to the water. The coach positioned himself on the bank, this being just one of many viewpoints which can be adopted by a coach. The coach then provided a series of exercises from which he was able to evaluate performance.

The coach gave feedback after each exercise. The method he utilised for this consisted of allowing the participant to return to within good earshot, then allowing the participant to ‘arrive’ both physically and cognitively, before exploring the activity with the participant.

12.7.5. Observations and data

The coach used a steady tone to communicate. The coach allowed time for the participant to undertake the tasks. The coach observed from a distance, not up close.

The coach’s key initial observations of the participant were that there was a dynamic movement happening below the deck and a wobbling or throwing of the head to the opposite side to the paddle stroke.

The coach set up a course and asked the participant to paddle in a straight line, suggesting that this was the most complex task to achieve. Following this the coach elongated the task, creating a triangular shaped course and using field glasses he suggested that this shape of course would allow the participant space to perform naturally, and with the wind quartering on different sides of the boat.

Passing me the field glasses, he asked me whether I could see the pulsing wave motion at the bow of the kayak as the participant got into his paddle stride. The coach suggested that there was a weight shift going on in the kayak. The boat seemed to shift gently from side to side, despite the participant's balancing head action. He suggested that this might be something to do with either the seat or the position of the feet.

The participant was then asked to paddle quite hard, very close to both myself and the coach. This revealed more aggressive tilting and a knocking side, which we both thought resulted from the participant's feet flopping from side to side in the cockpit.

12.7.6. Personal reflection

12.7.7. Experience

This session involved me helping a single participant to work with a top level coach on flat water. The aim of the session was to reveal what is inclusive paddlesport. The session lasted approximately one hour on the water.

12.7.8. Express

This felt like a good experience, as the coach helped me understand in practice many things I had experienced as a coach and had examined in the desk research for this study.

The observations make me feel nervous that there may be more of a difference to inclusive paddlesport than meets the eye. However, I felt heartened that standard coaching procedures seemed to reveal facts concerned with adaptive paddling practise.

I also felt that this study showed that small-scale sessions can reveal large amounts of data. The participant seemed to enjoy the experience, but I felt that the rather contrived setting of not being on a sea kayaking journey made the session a little bit of a chore for the participant.

I felt that for the coach this event was nothing special, and one of the key reasons for him to be able to give up his time during the day was because he had broken his wrist and saw this as a secondary priority to his mainstream, high level coaching.

I feel that there is a conflict for me as a designer researcher. The low key sessions are much easier for gaining data from, but provide much more challenge when it comes to securing participants and support.

12.7.9. Examine

Observation in terms of position and observational cues were experienced. The length of practice, the set up of the performance and the performance environment were also explained.

The coach made initial observations by observing the participant paddling without any specific instructions. He then took further observations after setting up a course. Final observations were taken at closer proximity to the participant once he had been asked to paddle with more force.

The coach involved me in the observations through passing me the field glasses and having discussion about what we were observing.

The coach did not seem to utilise any additional techniques once the environmental access, equipment and planning considerations had been overcome. The emphasis on access issues was placed on myself, as the researcher-organiser.

12.7.10. Explore

I would like to explore my role as a coach-observer further.

My overall feeling is that in order for studies like this to be effective, the coach-observer-organiser role needs to be amalgamated and sessions need to be run in parallel with meaningful experiences rather than contrived sessions.

Finding intermediate level paddlers is difficult. Such individuals are keen to overcome barriers to participation and so as soon as they participate more they become aspirant high level paddlers. By nature, these are very driven people who rather than being critical users, are actually lead users. This may mean that in future, studies without a 'wow' factor which require a larger number of participants may need to be based around either complete novices or high level paddlers.

12.7.11. Conclusion

Study 5 gives a reflection on the techniques used by a highly qualified coach when trying to understand the needs of disabled athletes in a sea kayak. The project utilised notes written at the time of participant observation to inform the researcher.

Coaching sessions were found to provide direct educational output for both the participant and the designer. There was also a commonality between the coach and the designer, who are both required to understand the task in hand. This suggests that participatory field-based sports equipment design is learning for all stakeholders.

The key difference between an inclusive coach and non-inclusive coach is the level of organisational and planning commitment which they choose, rather than their ability to educate, or coach, their sport. The set-up of the environment, clarity of objective and simplicity of task help to identify potential changes to performance for the performer in a coached session.

This may differ when working with participants who have different functional requirements.

Figure 53 Loch Morlich - Near Aviemore

12.8. Study 6 Inclusive 4* Training with Integrate Paddling/BIB, Skye – July 2002

12.8.1. Aim

The aim of the study was to see if it is possible to run an inclusive sea kayaking event that meets the needs of both disabled and non-disabled people, and to see how a high level coach would cope with a group of disabled and non-disabled kayakers in a formal coaching setting.

12.8.2. Method

Potential participants were invited to attend the course. Information was provided about the course, location and costs involved, as well as information about the PhD research study.

Participants and the coach were observed on the course, discussions were had with the coach, and notes and jottings were recorded.

Post-course questionnaires were handed out to the participants.

A reflection was written later, using Greenaway's '4 E' method; experience, express, examine and explore.

Issues concerning the planning and logistics of this study are given in Appendix E.

12.8.2.1. Sea Kayak 4 Star Pre-Course Questionnaire

Name

Also known as……………… (or formerly!)

1. How long have you been sea kayaking?

2. Do you have any BCU or other relevant canoe-sport qualifications?

3. Have you any BCU coaching qualifications?

4. What would you like to gain from this course?

5. Please state how much time you have spent in a sea kayak before the course.

6. If you have any sea kayak experience then please outline your strengths.

7. If you have any sea kayak experience then please outline the areas that you feel that you would like to work on.

8. Please describe any journeys that you have undertaken in a sea kayak – including length and water conditions.

Please consult the four star syllabus if you need.

12.8.2.2. Information provided in the pre-course questionnaires:

	SMC	CG	CW	AD	KD
1	On and off – 8 years – very irregularly.	1.5 years with the club, and intermittently for 10yrs before.	Regularly for the last, although did sea proficiency course at Plas Menai in 1985. 19 years inland white water experience.	First sea kayaked about 1985. Have done intermittent sea kayaking regularly since.	6 years
2	BCU Prelim (years old equivalent to 3 star!)	1*	1-3* inland, inland proficiency, sea proficiency	Crops of canoe lifeguards award Proficiency	No
3	No	No	Inland trainee instructor (elapsed)	Level 3 - inland	No
4	More confidence on the water – improve sea kayak skills – enjoy the scenery and have fun.	Increased confidence in rougher seas, and to be a more competent member of a team.	A greater knowledge of kayaking and techniques and expedition organisational skills specific to the sea.	Confidence Training on navigation/ planning trips with complicated tides. Advice on landing/	Competent member of a group and more skills for personal and group paddling safety

	SMC	CG	CW	AD	KD
				launching	
5	Equivalent to about 10 days total over a number of years – feel very rusty	2 weekend trips - Moidart, Loch Morar 1 day's trip- Montrose 10 evening paddles	One week sea proficiency (1985), approximately 20 paddling trips over the last 2 years, including 3 weekend expeditions with overnight stays.	Before injury: 3 days + 20 sea kayaking in general purpose boats After injury : 9 days	A fair bit... regular paddling each summer for the last 6 years – 4 full weeks spent touring the Western Isles, some foreign paddling – Iceland, Australia. Approx 4 west coast weekends per summer for last 6 years.
6	Not sure what they are... reasonable common sense and a sense of humour	Reasonably strong paddler. Have some paddle strokes. Done some surfing(Aberdeen beach)	Ability to keep boat well balanced in rough water. Stamina for long distances. Good support strokes and rolling, can assist novices with paddling techniques	More confident than most disabled paddlers	? Staying afloat!

	SMC	CG	CW	AD	KD
7	Safety skills (rescue and self rescue), paddling technique and steering strokes.	Paddle techniques, rescue techniques, planning for trips.	Any techniques specific to sea kayaking (most of my experience is on inland water and I can't remember much about the sea proficiency course 17 years ago). How to assess conditions and make sensible decisions about which route to take and how to say NO if the conditions are too rough.	Planning trips - timing	Investigate possibilities of using a single sea kayak. Create confidence in the event of going over – rescue drills, probably one for the pool Develop a reliable postural support.
8	Two 3-day trips in NZ – open water, varied conditions max 2m swell. Couple of day trips in NZ – including near	Moidart; 2 days, approx 15 miles per day. Wind day 1: SW2-3, sunny. Day 2 S1-2, foggy. Some residual swell on both	Lots of local evening trips – conditions have varied from calm to choppy. 2 days around North Uist and Berneray (15	1985 – Rhossili to Barry – in general purpose boats (1 week). 1990s – round Anglesey; trips as	Outer Hebrides, West coast of Lewis/Harris, East coast of Lewis/Harris, Monarch Islands (western Uist), East

	SMC	CG	CW	AD	KD
	death experience in Akaroa Harbour	days, approx 1m with reflection off the cliffs. Loch Morar: November, cold and clear, calm. Approx 9 miles per day for 2 days. Montrose: Onshore sea breeze 2-3, large residual swell 2m around points. Approx 5 miles	miles) – flat calm 2 days around Mallaig and Loch Morar (20 miles) – day 1 calm, day 2 tail wind and small swell 2 days on Loch Ericht (20 miles) – Dalwhinnie to Ben Alder Cottage day 1 calm (took 2½ hours to get there) day 2 very strong head wind (took 8 hours to paddle back!) ½ day around Summer Isles (3 miles) – very large swell – rather concerned about novices with us, so turned back.	instructor for Loch Eil OB – Mallaig area/Loch Shiel; Elgol – Glen Brittle – Soay (stag weekend) 2002 – Flekke Sognafford – Bergen 8 days Day trips in Cornwall, Perbroke, North Wales, Scotland.	cost of Uist, Hebridean Challenge – Sound sof Harris, The Minch – Shiant Isles (water conditions for Hebrides experience varied from flat calm to around Force 6), Isle of Skye, Applecross and various other West coast locations, variable sea state. Various East Coast paddles, varying sea state. Strongest sea state I have kayaked in is approx Force 6 – didn't like it too much.

	SMC	CG	CW	AD	KD
			1 day on Cromarty Firth (5 miles) – conditions changed from flat calm to extremely choppy in a couple of hours. One novice paddler capsized.		

12.8.2.3. Information provided in the post-course questionnaires:

Question 1: Did the course meet your needs?

Person 1: Course was very enjoyable and helped a lot to feel more confident on the water, especially through knowing all the different paddling strokes, support strokes and rescue techniques.

Person 2: Yes – it covered the 4* syllabus and gave me confidence that I could get back into the boat from the water.

Person 3: Generally too basic for my personal needs but fine as a 4*

Person 4: Yes. Has given me more confidence in paddling ability and in the rescue of both able and disabled people.

Question 2: Were the exercises suitable for your level of knowledge and ability? Person 1: Exercises were suitable for my knowledge, was able to improve and practice paddling techniques. Most of the strokes and techniques were not new to me, but was able to concentrate on the accuracy/precision of my strokes and techniques. Person 2: Although the initial exercise on sweep-strokes felt long/drawn out they were beneficial as they had overlapping benefits for the other exercises. The course certainly made me think about how to improve my paddling rather than being satisfied with my level – some more information on tidal planning would be useful, for other crossings. Person 3: No – too basic, although I did learn a few new things Person 4: Yes, known techniques were tidied up and practiced. New techniques were described well, with plenty of time to practice, with good feedback.
Question 3: Do you feel that the course addressed the aims of the BCU four star test syllabus? Person 1: Good cover of all the paddling techniques and rescue but I was missing the theory part such as knowledge about weather, safety gear, map reading and general orientation on water. Person 2: Yes Person 3: Yes, apart from kit check, which was not carried out. Lunch on day 2 would be a good time to do this. Could have been more instruction during the day 2 expedition. There was virtually none. Person 4: Maybe more time could have been spent on awareness of tides, weather & currents on paddlers – so that the reasons why the boat does strange things in wind and waves is understood. More could have bee made of the Sunday, for tuition on paddling techniques in open water & rougher seas. Also how to be a good member of a group. There was no chart work at all or knots.

Question 4: Was the location suitable? Person 1: Skye is an excellent area of sea paddling and also offers locations with more shelter if required. However, involves quite a lot of travelling to get there for a two days' training course. Person 2: Excellent – very sheltered for first day and a lot of options for the second day. Person 3: Yes – excellent. Person 4: Maybe a slightly more sheltered location for the initial training, but it probably was nearer real conditions so helpful for when going out into choppier water on a trip.
Question 5: Was the coaching varied enough to keep your interest? Person 1: I especially enjoyed the second day when we paddled out on the sea and along the coast and could use all the paddling strokes learned the day before. Person 2: Coaching was good – the initial session on sweeps felt long at the time, but I can see benefits of doing them thoroughly Person 3: Too much time spent on sweep strokes, on morning of day 1. Could have spent more time on support and other strokes and rescues instead? Person 4: Yes, even old techniques were given a new slant or improved on. Although Sunday was a lovely paddle and I wasn't bored, I don't think I learnt much.
Question 6: Did having both disabled and non-disabled participants on the course affect your enjoyment of the course? Participant 1 No not at all. Participant 2 No they are just friends of mine

Participant 3 No we all got along fine Participant 4 No Don't see any reason why it should!
Question 7: Did having disabled and non disabled paddlers on the course affect your learning on the course? Participant 1 – No I knew the make up of the group and feel that everyone worked hard to make things happen, I was a bit dis appointed by the lack of preparation by the Sea Kayak Coach Participant 2 – No not really, although I would of liked to do some more journeys and felt that we were a bit restricted by the type of venue that we could use. Participant 3 – No, but feel that the coach should have had some answers with regard to the rescues Participant 4 – No SP worked hard behind the scenes to make sure that we all managed to get on and off the water, feel that the moving and handling of equipment and boats for people was a bit of an issue.
Question 8: Did the accommodation suit your needs? Person 1: Excellent accommodation with nice, friendly atmosphere and close to the sea. Person 2: Accommodation was good – Trevor and Joan were superb. Person 3: Yes – excellent Person 4: Yes – very comfortable and friendly staff. Enough room for large groups
Question 9: Was the pre-course information suitable? Person 1Information given on the course was very helpful and informative. It would be good to have some kind of a course timetable, so that people know what will be done each day and can pack and dress accordingly. Person 2: Yes - see below

Person 3: Yes – excellent. Thanks, Suresh Person 4: Yes – very informative, and allowed us to be easily prepared for the course.
Question 10: Any other information that can be applied for future courses of this type. Person 2: An outline of a programme for the weekend would be good, although obviously conditions on the day would change plans. Person 3: Maybe should spend time trying different strokes in different water conditions (unless totally flat calm), eg ferry gliding, trying to keep a straight course in a cross wind, landing & embarking in small surf (if there is any), ie learn strokes & then put them into action at sea. Ratio of instructors to pupils should probably be higher than for conventional training courses as there are a broader range of abilities/needs to be catered for. Will vary depending on range of levels of disability present together. 1:5-6 probably OK, preferably working in mixed ability groups. Maybe allocate more time to rescues, to become more slick and to correct/find solutions to any problems. This is a crucial safety issue. Could time rescues & try to carry out rescue within a max time (maybe longer for disabled than abled). Not enough kayaks provided, & instructor in inappropriate boat on day 2. Poor choice of lunch spot on day 2, AD forced to lunch in his kayak Poor value for money given that most of the organisation by the Sea kayak provider and ½ the instruction was done by SP on a voluntary basis. Person 4: As an inclusive course, possibly more consideration into sites to stop for lunch, so that everyone can find a safe and 'inclusive' place to rest or get out of boat. Maybe techniques for rescues etc that have been devised for the disabled people should be practiced by everyone in the group, like role play, as we can't expect them to capsize and be rescued by everyone in group.

12.8.3. Day 1

12.8.3.1. Setting/Access and Egress:

Sheltered bay with easy access using wheelchair or walk from the bunkhouse.

The venue had been chosen because of the slipway, bay and small pier or prominatory that extended into relatively deep water, all connected by shingle beach. All these features made the location friendly for teaching.

The slipway was used to facilitate egress and access, allowing the participants to transfer in and out of the kayaks. They used a 'seal launch' in. A small pull and some lateral support allowed the kayaks to be on dry land before access and egress.

A small amount of damage to the bottom of the kayaks was observed, which would need to be resolved for longer term inclusive projects.

12.8.3.2. Viewpoint:

I observed form the bank. The coach had not supplied sufficient boats, so that neither the coach nor I could be on the water.

12.8.3.3. Coaching Content

12.8.3.4. Paddling Skills

The coach used mainly verbal instruction and some visual paddle gestures to run through basic strokes: forward paddle, stop, sweep and stern rudder

Discussions with the coach revealed that he felt that all of the skills were undertaken normally. He reported three adaptations, as follows:

- lack of trunk rotation
- limited edge/lean

- reclining seat posture

12.8.3.4.1. Forward paddle:

The coach said that the aim must be to reduce the amount of movement in the upper body, as well as keep the boat flat in the water.

12.8.3.4.2. Low brace turn (involving sweep and low brace):

12.8.3.5. Sweep Stroke

Almost standard paddlegrip used, but poor trunk rotation and finished at the hip.

There seemed to be additional balance gained by throwing the head to one side during the turn. In other words, the head seemed to be used to mimic the feet of a non-disabled paddler. In general it seems that the head is like the rubber band in the wind up mechanical system, which can provide additional power and emphasis to the stroke.

Timing of moving the body segments in relation to the path of the paddle is crucial. In particular, the head seems to moved sympathetically to the path of the paddle, dependent on whether it is either closer or further away than the centre of the body.

12.8.3.6. Low Brace

Seemed to be very heavy or paddle dependant, using the head as counterbalance to the paddle action. The timing of head flick and paddle support seemed to be crucial to the success of the stroke as a whole.

12.8.3.7. Deep Water Rescues

The following rescues were undertaken with SCI and non-SCI paddlers as victims and rescuers. The rescues were attempted in both single and double kayaks:

- X
- XI
- scoop
- over the back

12.8.3.8. Single Kayak Rescues

These were rescues involving individuals utilizing single kayaks only, and involved both disabled and non disabled participants. The most successful rescue for recovering both SCI participants was the scoop rescue (scoop and pump). Acting as a rescuer, the most successful rescue was the x rescue, perhaps with the addition of another craft to provide assistance.

12.8.3.9. Double Kayak Rescues

These were rescues involving individuals using both double and single person kayaks with disabled participants operating as victim or rescuer from inside a double kayak only. Only scoop rescue was attempted using the double. Lifting a fully laden and swamped double was too much load and was decided to be damaging to backs and boats. A scoop rescue was successful.

Both paddlers in water

SCI paddler assisted to float legs into cockpit, ie with head almost in water. SCI paddler held cockpit rim to maintain contact with seat

Non-disabled paddler still in water assisted to right kayak from lying on the side to upright

SCI paddler pumped out own cockpit and used deck pump

Replaced spray deck

Used paddle float and low brace to support as non-SCI paddler got into own cockpit, pumped out and replaced deck

Paddled away

Inclusive Rescues need a bigger platform and more time, just as when dealing with an injured participant.

12.8.3.10. Discussion with coach at the end of Day 1

I had a discussion with the coach at the end of Day 1, as there was a need to more fully define the term ‘intermediate paddler’ in the context of this course.

The 4* course has been a training ground for those paddlers with aspirations to be a level 3 coach, but if as a result of their impairment the individual is not able to perform some of the requirements of coaching in a dynamic environment, then should this course be available to them? Could the disabled people on this course ever get to a level where they would be sufficiently proficient to coach in a dynamic environment in terms of being both a competent group member and self sufficient?

The coach used the example of the limited head turn available to the disabled participants on this course. This would limit range of sight and the ability to look into future water (where you want the boat to go). It would also change the tilt of the boat. Together these could affect the ability to turn to see individuals/the group or perform a rescue.

I broke the requirements for coaching down into three distinct areas; teaching/coaching, leadership/planning, action. While I recognized the potential for limited action, I recognized that it might be possible to train the individuals to make the most of their line of sight and position of maximum usefulness in order to overcome deficits in their performance of any action.

The coach also pointed out that while he was not able to demonstrate all strokes taking into account physical impairments, disabled coaches would similarly not be able to demonstrate performance of strokes to be made by a non-disabled person. We discussed whether having an appreciation of individual differences was sufficient, or whether this still limited opportunity for success in performance.

We discussed how there is a need to always adapt everything to suit participants, so questioned whether this was any different.

12.8.4. Notes from Day 2

The focus of this day was a single return journey undertaken from the training venue utilised on day 1.

Launching and landing was of no real concern and there were no revelations.

The journey lasted approximately 5½ hours, with a small lunch stop, rock hopping and a visit to some sea arches.

All of the group seemed happy and relaxed.

AD was paddling solo. He found paddling into waves the easiest and cross wave manoeuvres the most difficult. At the end of the day AD seemed very unsteady and reported that the day was very tiring.

KD seemed happy in the douple capella sea kayak.

12.8.4.1. Personal reflection:

12.8.4.1.1. Experience:

The course ran over a weekend, with a team which consisted mainly from an inclusive paddling/sea kayaking club from Scotland. The accommodation was basic but largely accessible. The venues for sea kayaking could be accessed for sea kayaking using small slipways or concrete platforms which shelved off into the sea. This allowed for easy access and egress for both disabled and non-disabled participants. The coaching and standard equipment provision was undertaken by an experienced sea kayaking coach from the local area.

The course followed a 4* syllabus, as prescribed by the BCU, focussing mainly on practical sea kayaking rather than issues concerned with tidal planning and sea kayaking theory.

12.8.4.1.2. Express:

I felt that this course had real potential. However, I felt that it did not reach this potential because of the lack of standard equipment, meaning that a full range of coaching techniques could not be offered. Additionally, I felt that this hampered the creativity of the coach, and felt that his input was stifled by his lack of presence on the water.

I left the course feeling that the top level coach used had been scared of disability and this had affected his performance. I felt he was scared of not knowing what to do, or of getting it wrong, or of simply being a top level coach who could not account for disabled paddlers all the given situations. The course feedback reflected this, as participants stated it was a fairly standard course, rather than an inspiring event. I would have expected this to be an inspiring event as the course was run by a level 5 coach on their home turf.

I felt disappointed by the performance of the coach. I had to work very hard to draw out any learning or appreciation of disability.

For me, the course represents a bit of a missed opportunity, and whilst I felt that the course revealed one or two key issues concerning re-entry of a boat following a capsize, it did not fully explore the consequences or potential solutions for adaptive sea kayaking rescues.

12.8.4.1.3. Examine:

The logistical elements for this course did not seem to interfere with the coaching. The coaching provided, however, was mainly bank-based, as the coach had turned up to run the session with too few boats. This meant that the range of coaching styles applied by the coach during the two-day course was limited to description and gesturing from the bank. On day 2 of the course, a journey was undertaken, which was a success although hampered again by the lack of boats. As a result, both I and the coach travelled alongside the participants in an open canoe, which is a different kind of boat to a sea kayak. This did not allow me any space to observe the coach, however I was able to hear all the feedback which the coach offered to each participant.

The feedback centred on the timing of a stroke, the placing of the paddle in relation to the boat, and the edge or lean of the kayak to help change the hull shape of the kayak, and therefore assist in the manoeuvring.

During the final session on the second day, a series of get wet rescue scenarios were set up. This involved all participants at some point being in the water, regardless of disability. Observing or paying special attention to the disabled participants, I observed that it is useful to have the largest possible aperture, to allow floppy legs to be floated into a semi-capsized sea kayak cockpit.

Observing the coach, I noted from the bank that the questions the coach asked were, "So how would you do this, and what do you suggest?"

During the debrief for the course, each participant was interviewed to identify what areas of sea kayaking they would like to work on to enable them to paddle better. Additionally, participants in the course were given the opportunity to speak confidentially about what they felt about the course. The disabled participants were both given rescues as a development point during the debrief, and notable feedback from the other non-disabled participants centred on the balance of attention of the coach to the disabled members of the course at the expense of the non-disabled members.

12.8.4.1.4. Explore:

It is necessary to remove as many external influences on the testing as possible in the future.

It is also necessary to use a wider range of coaching techniques to reveal what is happening on the water.

Equipment issues need to be focused on in future, as this seems to be inextricably linked to coaching and performance.

Intermediate sea kayaking is not from a single venue, and so it is important to see the influence of different environments on the performance of both the coach and the participants.

12.8.5. Conclusion

Study 6 provides a reflection on whether it is possible to run a sea kayak training course catering for disabled and non-disabled people, observing the work of a high level coach in the process. It utilised participant observation, discussions with the coach and post-course questionnaires to reveal the findings.

Post course questionnaires showed that it is possible to run an inclusive sea kayaking event that meets the needs of both disabled and non-disabled people. The participants all felt they had benefited from the course and had enjoyed being with their friends. This may well have influenced their answers to the questions about being in an inclusive group.

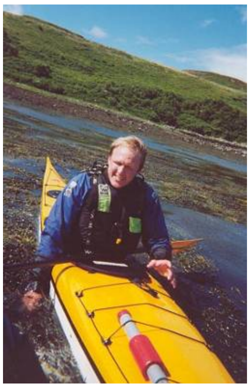
Observations and discussions revealed that although the coach was able to deliver the necessary technical information, the coach felt out of their comfort zone when working with the disabled members of the group and this affected the overall experience for all.

While non-disabled paddlers have a huge choice when looking to access a course, disabled paddlers do not benefit from this same choice and this may then limit their opportunities for progress.

Not being on the water limited some of my observations, as did not being directly involved with the coaching and not being able to immediately address equipment needs. This reduced the number of learning and feedback cycles available.

Coaching/leadership is an art, not a science, and so the need is to provide resolution, not solution, when addressing task, team or individual and equipment. This may involve adaptation in a range of different settings, being that the outdoor sea environment is constantly changing.

12.8.6. Images

12.9. Study 7 Canada to Alaska Sea Kayak Expedition 2003

12.9.1. Expedition

12.9.1.1. Introduction

In the summer of 2003, a group of sea kayakers were the first inclusive paddling team to embark on a 1000 mile, 3 month journey through the fjords and glacier-draped mountains of Alaska and British Columbia's coastline, following the Inside Passage. The team consisted of a highly motivated group of 8 disabled and able-bodied paddlers.

The team's journey followed "The Inside Passage", an intricate and exposed waterway used for generations to link First Nation fishing and whaling communities of the northern stretches of the Pacific to the icy waters of the north.

It was the first inclusive paddling team to confront the challenges of the northwest reaches of the Pacific Rim. Travelling by sea kayak, the team will be challenged by open water crossings, volatile seas, a harsh and barren landscape and difficult landings.

The effort was used to encourage participation of disabled people in outdoor and adventure activities through a series of educational talks and presentations to youth and community groups across the U.K.

The aims of the expedition were to:

- Be the first inclusive team to attempt to kayak the length of the 'Inside Passage' seaway which joins Vancouver to Alaska.

- Enable and illustrate methods of accessing wilderness places for people with disabilities.

- Share the experience and inspire others through a series of educational talks across the UK.

12.9.1.2. Why this was important

2003 was the European Year of the Disabled. Eight years on since the original Disability Discrimination Act in the UK much had been achieved. Yet the need is to continually question and explore the 'can do' ethic in order to provide a stream of media images, practical examples and inspirational stories to fire the mechanism for positive social change towards a diverse, equitable culture in a sustainable way.

12.9.1.3. New knowledge – expanding opportunities for all in exploration

The team carried out fieldwork, testing equipment developed to facilitate access to the outdoors and the water for disabled people. The field-testing results will be fedback to researchers at Adventure Designs at Brunel University. Inclusive coaching and logistical practices will be recorded by Equal Adventure Developments. The combination of new equipment and new inclusive practices were used to benefit other inclusive initiatives through future development programmes run by the charity Interventure.

12.9.2. Research Study

12.9.2.1. Study Aim

To identify factors which affect the performance of two lead user kayakers with SCI in their flow state in a field expedition setting and to assess the efficacy of two prototype pieces of equipment to drive an iterative design process of seating solutions.

12.9.2.2. The Participants

The study involved one man and one woman, both with SCI as a result of traumatic injury following climbing accidents. Both participants kayak regularly and trained for the expedition. Both participants had taken full participation in the planning of the expedition and had been part of previous studies in this research.

12.9.2.3. Equipment Preparation

Two bespoke postural supports were constructed and for use on the expedition. KD utilised a 'Butterfly Back' postural support and AD utilised a carbon fibre hoop (based on a design he brought to the study).

12.9.2.3.1. AD Preparation

Consultation with AD prior to the expedition suggested that he did not want to change his postural support and then attempt the most challenging kayaking he had undertaken since his SCI. The following improvements needed to be made to the brace/socket on his kayak seat:

- The brace needed to be lighter – this could be achieved by using a lighter material (Kevlar) or making the peg part of the brace hollow.
- The padding needed to be better – more durable and more cushioning.
- The metal parts (hinge, pin & lock) needed to be covered to prevent them causing excess wear on the spray-deck.

- The pin needed to be replaced with something that was easier to operate with cold hands and could not be dropped into the water by accident. One of the adjustments that are used on Pyranha backrests was suggested, especially if it allowed some adjustability for when different thicknesses of clothing were needed.

- The brace needed to release from the socket reliably, whatever the paddler was wearing and even if the canoe had been paddled in dumping surf that had caused it to be pushed very hard into the socket. AD had ideas on this:

- Small blocks on the edge of the brace to stop it being jammed too hard into the socket

- Small block in the base of the socket to prevent the brace being jammed in too hard

AD requested any other ideas on how to make it easier to locate into the socket when wearing a spray-deck over the top of it, and on how to make it transferable between boats without sacrificing rigidity.

12.9.2.3.2. AD Additional Concerns

Things that I need to be particularly aware of on the trip or do before/during the trip:

Concern	**Action**
Pressure sores	Padding behind cockpit for getting in and out safely. Constant vigilance during trip Increased padding on kayak seat.

UTI	Get a supply of broad spectrum antibiotics.
Skin deterioration due to Salt causing drying Constant wetness from kayaking and sitting on the ground in wet campsites	Cleanliness. A supply of E45 or similar cream.
Foot problems: If I wear Tevas will feet be warm enough. Do they provide padding from pressure? If I wear wetsuit booties – foot rot	Constant vigilance. Making sure my feet are dry for as long as possible each day. Looking into all the footwear alternatives before departure.
Moving around on land will inevitably cause me to pick up some minor nicks/splinters in my hands that may deteriorate through constant paddling	Heavy duty gardening gloves for moving on land.

12.9.2.3.3. Action

I worked with AD to source foam for seating, gloves for hands, and river footwear. In terms of support I remade the carbon fibre hoop and inserted a block at the base of the location slot to help reduce the likelihood of the support jamming.

AD tested all solutions during the final preparation weekends prior to departure. All solutions seemed satisfactorily functional and robust.

12.9.2.3.4. KD Preparation

I worked with KD to create a design solution for a new postural support. This became known as the butterfly postural support. In addition, Akton gel ankle pads, and wet suit boots to protect feet and ankles were also provided.

Additional clothing was also sourced to help KD maintain her core temperature. Once again KD suggested that she wanted to utilize her old postural support (simple foam pad) during the beginning.

12.9.2.3.5. Personal Hygiene for KD and AD

A field toilet was supplied by the new team at Adventure Designs following my departure and was made in country prior to setting to sea, as the prototype was delivered two months late and failed on its initial test. The new prototype functioned successfully throughout the expedition and proved to be robust and portable, forming the basis for a production item following the expedition.

12.9.2.4. Method

The proposed length of the expedition (approximately 70 days) was chosen to ensure that the team members could be observed in their true state of performance, or flow, as identified by Csikszentmihalyi and Csikszentmihalyi (1991).

There were last minute changes in team structure and make up of the team as a result of the withdrawal of the field leader two weeks prior to departure, due to a mountain biking accident causing separation of the AC joint at the shoulder.

SP's original role was to be solely focused on research, utilizing observation and semi-structured interviews in the field. His new role was to be field leader as well as researcher. This required a change in method, to ensure that both field and research roles were able to be completed by the one person.

12.9.2.5. Method Utilised

The researcher's observation point had to be changed to accommodate the new field leadership role. The original plan was for SP to paddle solo, to enable observation of the technical and performance components of the disabled members within a whole team. The field leader was to paddle in the back seat of the double with KD (one of the participants with SCI). This position had to be taken by SP, meaning that he would not be able to effectively observe all members of the team. With less time available for conducting research, a reflective method was utilised to gather information. SP wrote jottings during rest periods and at the end of each day, providing his own viewpoint without any input from other members of the team.

The format used to write up each leg of the expedition was as follows:

- Experience – What
- Summary of experience
- Observations of AD
- Observations of KD
- Changes and amendments

Express – Feelings

Examine – Detail

Explore – Plans and Design and New Targets

12.9.2.6. Introduction to Reflective Log

This was not intended to be a full expedition diary, containing logistical and route information, as that was contained in the full expedition report. The focus of this log was on the technical, performance and team issues which needed to be addressed in order to make the expedition successful in terms of inclusion.

Each leg commenced with a table summarising the navigational and meteorological aspects of the expedition. This was followed by the Reflective Log, which covered the research aspects of the expedition. This was taken from the, 'Day by Day Log for Interventure Sea Kayak Expedition Vancouver to Juneau Summer 2003'. (Interventure 2004)

12.9.2.6.1. Key

Day – number of days of expedition

Date – day/date/month

From – where team left from, broad indication only to reduce possible 'honey pot' impact on sites

To – where team remained overnight, broad indication only to reduce possible 'honey pot' impact on sites

Distance – in kilometers, imperial miles and nautical miles

Type of Accommodation – camp and/or bivi, hotel, motel or cabin; detail of features of beach and campsite, availability of water, bear activity

Weather – wind and precipitation, also tidal info

Notes – other notes of interest about day including route taken, wildlife sightings, indications of other campsites and water sources

12.9.2.7. Results - Stage 1 Vancouver to Big Bay, 9 Days (Full Team)

Day	Date	From	To	Distance	Accommodation type	Weather	Notes
Stage 1 Vancouver to Big Bay							
1	Fri 13th June	Jericho Beach, Vancouver	Wilson Creek	40kms/ 25mls/ 22nm	Camp/bivi -next to Girl Guide camp therefore private property; no water; sharp bouldery shore exposed at LT; difficult launch in swell	Drizzly in early am. Cleared to warm and sunny day, wind and tide from SE. Tidal streams with us all day.	Busy with boat traffic; beautiful section but many beach houses; very fast progress
2	Sat 14th June	Wilson Creek	Smugglers Cove	25kms/ 15.5mls/ 13.5nm	Camp/bivi - deep mud at LT; no water; very steep (although short) carry up from non-existent foreshore	Cool and drizzly start with wind from SE made for awkward launch into surf. Improving conditions.	Marine Park; too many of us in quiet campsite; 3 kayaks floated away overnight
3	Sun 15th June	Smugglers Cove	Quarry Bay	22kms/ 14mls/ 12nm	Camp/bivi -excellent pebble beach; good separate rock bluff for cooking; very clean; no	Hot and sunny day with favorable wind from S-SE	Collected water from Secret Cove Marina; beautiful section past

Day	Date	From	To	Distance	Accommodation type	Weather	Notes
					water		Agamemnon Channel
4	Mon 16th June	Quarry Bay	Grief Point, Powell River	33kms/ 20.5mls/ 18nm	Camp - offered comfortable grass lawn to camp on; water at Marina; difficult carry up broken dangerous slipway from sandy beach	Hot and sunny; NW headwind developed off Stillwater Bay in pm	Built up area so limited campsites; some IR lands as well; PG's wrist very sore
5	Tue 17th June	Powell River	Copeland Islands Marine Park	31kms/ 19mls/ 16.5nm	Camp -tailor made camping and cooking platforms; no water; composting toilets; straightforward carry; fire ring	Sunny day with light winds	Moving past industrial section into wilder areas; last of BC Sunshine Coast road at Lund
6	Wed 18th June	Copeland Islands	Lewis Channel	29kms/ 18mls/ 15.5nm	Camp - old logging camp; fresh water; sandy and stony but flat; steep and sharp landing and launch area; needed to be protected by wood	NW F3-4 wind against us most of the day; warm and sunny	Very late finish in dark; v.limited campsites

Day	Date	From	To	Distance	Accommodation type	Weather	Notes
					debris; fire		
7	Thurs 19th June	Lewis Channel		Rest day	Camp	Hot and sunny ; ideal for washing and drying	Washed and dried clothes; personal washes; sorted out kit; cooked pancakes
8	Fri 20th June	Lewis Channel	Big Bay	27kms/17mls/ 15nm	Camp - camped on lawn at Big Bay; rather muddy and smelly landing	Drizzly start but cleared to warm and sunny day; strong tides	Given oranges and fruit juice at fishing lodge on Rendezvous Isl. Yaculta rapids at end of day – flat calm
9	Sat 21st June	Big Bay		Rest day	Camp - showers; spare wheelchair; bakery and restaurant; store and laundry	Hot and sunny all day	Stayed at Big Bay as Adi had developed pressure sore; BB private resort but very welcoming

12.9.2.7.1. *Experience – What*

12.9.2.7.1.1. *Summary of experience*

This was a relatively sheltered period, which allowed for settling in. The leg took us from Vancouver into the relative wilderness of the 'Inside Passage'. Launching and landing, moving and handling, roles and responsibilities, relative speeds of different craft and interpersonal relationships were settled during this leg.

There were large loads in the holds of each kayak and therefore it took a long time to pack and adjust personal standard equipment. SP paddled from the back of the Aleout, which was perhaps the slowest boat and thus presented a logistical and leadership challenge with regard to keeping the group together.

A late night paddle searching for campsites resulted in a late and rather rushed start the following morning. AD must not have checked his seating surface as at the end of the day's paddling he found he had been sitting on a small stone. This had resulted in a mark on his skin, on his right buttock. During the following three days AD gained the start of a pressure sore (ducubitus ulcer).

12.9.2.7.1.2. *Observations of AD*

AD used a postural support made up of a glass fibre hoop around his waist which had a locating pin going into a socket positioned at the rear of the seat, with additional padding and adjustment. AD was in an Explorer LV.

12.9.2.7.1.3. *Observations of KD*

KD used a foam back pad in a double Aleout, suggesting that there was “enough to get used to at the moment”, and did not feel that she was in a position to use the winged postural support that had been created for her to use during the expedition.

12.9.2.8. Changes and amendments

At the end of the leg, at Big Bend, AD elected to rest for the duration of the next leg. A local staff member from the resort at Big Bend volunteered to look after him and rendezvous with the team at the end of the next leg.

12.9.2.9. Express - Feelings

This was a personally challenging leg, with very little real time to do much more than act. Observation was very much through doing, or immersion in experience. Both participants seemed strong on the water and good progress was made each day. The most challenging component to the leg was maintaining the forward speed of the double sea kayak which I was paddling with KD. On landing the priority was moving, handling and organizing the camp. Due to the shallow beaches, there were long walks up and down beaches with boats, people, personal equipment and other kit. The amount of personal kit required by KD and AD meant that it took a long time to finish the launching and landing part of each day.

To reduce the environmental impact, cooking was done away from the tents and living was on the shore. This meant there was a second set of lifts after cooking. Any time for reflection and research was gained in the tent late at night when all the tasks had been achieved.

The team did not seem to settle with itself. There were two factions, the slower paddlers and the faster paddlers. Although the mileage was being completed there was a tendency to want to do more than was necessary to achieve the journey in the allotted time.

Discussions with AD revealed that he felt time pressure from some of the faster members of the team, resulting in him rushing. This may have contributed to

AD's lack of attention whilst preparing to set off, so that he did not check his sitting surface and did not notice the stone.

12.9.2.10. Examine – Detail

Packing and co-ordination of personal routines was critical, as were water, food, shelter, planning and re-planning.

Packing: Large amounts of food and medical supplies, along with standard sea kayaking equipment, additional clothing and a field toilet had to be fitted into the confined spaces of a sea kayak through the relatively small apertures of hatches on the deck.

Personal routines: Both the disabled and non-disabled individuals were getting used to giving and receiving help in an organized manner.

Water, food and shelter: The team had to get used to the rations, cooking equipment and environment.

Planning and Re-planning: Due to the ulcer on AD's right buttock, there was a need to utilize more time for planning and re-planning. The wound was not stable and was likely to deteriorate without careful management by AD.

12.9.2.11. Explore – Plans and Design, and New Targets

There were some logistical issues that required further attention by the team and individuals within it. These included:

- make packing transparent so that those assisting could easily identify items
- set up packing and unpacking systems to help speed up access and egress to the water

- carry boats and people separately
- organize the group to complete individual and team tasks to optimal efficiency, within the changing dynamic of a field environment
- agree a rota for using the field toilet
- use a buddy or support system to ensure that the daily living tasks are achieved in time
- get support for the buddy

12.9.2.12. Leg Conclusion

The standard practice of packing group and personal resources and daily needs remained important systems. The dynamic expedition environment took time to get used to, so there was a reluctance to utilise new equipment. Each individual's personal drive had an affect not only on their own participation, but also the working of the team.

12.9.2.13. Results - Stage 2 – Big Bay to Telegraph Cove, 4 days (AD Resting)

Day	Date	From	To	Distance	Accommodation type	Weather	Notes
Stage 2 – Big Bay to Telegraph Cove							
10	Sun 22nd June	Big Bay	West Thurlow Island	30kms/18.5 mls/ 16nm	Camp- permission to camp on Millionaires Dock on east side of WTI; water on dock	Strong NW headwind developed; warm and sunny; strong tides made Greene Rapids impassable	Adi went to Vancouver Island to recuperate; Dent Rapids – very straightforward; Cordero Channel; v.limited campsites
11	Mon 23rd June	West Thurlow	Hardwicke Island	30kms/ 18.5mls/ 16nm	Camp/ bivi -gentle gradient, pebble beach and shortish carry but exposed to west; limited bivi sites amongst log jams; water	Strong headwind in Sunderland Channel. Good clear weather	Chancellor and Wellbore Channels.
12	Tuesday 24th June	Hardwicke Island	Stimpson Point	29kms/ 18mls/ 15.5nm	Camp/bivi - no water; long carry at LW as shallow beach	Still and overcast to start; clearing and wind picking up	Stopped @ Port Neville for water from post office

Day	Date	From	To	Distance	Accommodation type	Weather	Notes
						from NW	
13	Wednesday 25th June	Stimpson Point	Telegraph Cove	45kms/30mls/ 26nm	Campsite near harbour - toilets and showers at Fisherman's Mission (both wheelchair accessible), store and restaurant, whale museum , kayak store and rental	Overcast and calm then hot and sunny; wind from NW stronger in pm.	Johnstone Strait to Robson Bight but no orcas arrived as yet; found water on south shore (Vancouver Island); met AD at Telegraph Cove

12.9.2.13.1. Experience – What

12.9.2.13.1.1. *Summary of experience*

This was a mainly sheltered leg, with some coast hugging in the later parts. The kayaking conditions were mainly favourable, with either head or beam winds, which had little adverse affect on kayak performance. Team and logistical issues were relaxed as the ratio between disabled and non-disabled team members was higher, due to AD taking rest following injury in the previous leg.

12.9.2.13.1.2. *Observations of AD*

AD rested as a result of sitting on a stone, during the previous leg. Much group discussion concerning the way in which AD should participate in the expedition from this point onwards.

12.9.2.13.2. Observations of KD

Paddling into headwinds illustrated to KD that she was not producing sufficient power. KD tried the new winged support initially for half days, progressing to whole days during the last four days of this stage.

Discussions with KD revealed that her foam back rest was bending and that she had a very recumbent sitting angle. A decision was made to utilise the winged support which had been constructed for the expedition.

12.9.2.13.3. Changes and amendments

The main change for this stage was to give AD time to recover. Team roles evolved through group discussion both on and off the water. The order and timing of practical tasks were negotiated and re-negotiated.

12.9.2.13.4. Express – Feelings

This was an easier leg, and was enjoyable. KD only used the postural support on windy days or in rougher conditions. I felt disappointed that KD did not buy into the project more significantly. I was glad that the challenging conditions were appropriate and seemed to demand more of KD’s postural support, but were not strong enough to get the team into trouble.

SP was in the back of the Aleout with KD. With AD not on the water I felt there was less tension because of the reduced challenge and I could be more focused on KD and the rest of the team.

12.9.2.13.5. Examine – Detail

Discussions with KD centred around her posture, and concerned a short stroke resulting from a reclined position. During the really windy days KD admitted not being able to paddle as effectively as she would have liked.

Bespoke padding to splay and support KD’s legs and feet were rejected. KD used small dry bags between the legs to splay them and allowed her feet to be unsupported.

12.9.2.13.6. Explore – Plans and Design and New Targets

KD reported that she felt more powerful and less tippy, but too restrained by the height of the back support. KD felt that there should be a drop in her winged support by 20mm. Discussion between SP and KD led to KD agreeing to drop the height of the postural support in two stages (10mm and then a possible further 10mm). The drop would take the edge of the support to 10 mm below KD's reported start of sensation. SP agreed to drop the postural support by the first 10mm on arrival in Telegraph Cove.

KD stated that she may feel more comfortable at the extremes of her stroke.

I felt I needed to find a way to help KD buy into the project and let her explore the use of the postural support, making minor adjustments.

AD needed to find a way of participating in the expedition in a way that was not going to do further damage to his skin, whilst at the same time managing his desire to take on this challenge of a lifetime. (AD realized the reality that without a team willing to be inclusive of both disabled and non-disabled people this challenge would not be available to him.)

12.9.2.13.7. Leg Conclusion

The better the postural support the longer the stroke, as supported by the FRT.

Minor adjustments were necessary during the day, as posture changed with fatigue. Minor adjustments were also required during preparation to go to sea, while on dry land.

12.9.2.14. Stage 3 – Telegraph Cove to Port Hardy - 2 Days (Full Team)

Day	Date	From	To	Distance	Accommodation type	Weather	Notes
Stage 3 – Telegraph Cove to Port Hardy							
14	Thursday 26th June	Telegraph Cove	Peninsula opposite Port MacNeill on Broughton Channel	21kms/13mls/ 11.3nm	Camp/bivi - poor beach with long carry at LT and very slippery boulders; no water; built sleeping platforms on log jam	Cold northerly wind	Full team again; Broughton Strait past Alert Bay; pm start therefore late camp;
15	Fri 27th June	Broughton Channel	Port Hardy	39kms/24mls/ 21nm	Wildwoods Campsite	Clear, warm but windy. Swell between Dillon Point and Masterman Islands	Found bear scat & tracks on beach opposite Pulteney Point; hard pull into headwind
16	Sat 28th June	Port Hardy			Wildwoods Site – toilets and showers; laundry; large camp spaces; fire-rings and wood; lights and free homemade hooch	Fine and sunny all day	Campsite owned by Richard and Joanne Ranger; fantastic hospitality; very
17	Sun 29th June	Port Hardy				Weather broke in pm	

Day	Date	From	To	Distance	Accommodation type	Weather	Notes
							cheap; w/chairs didn't arrive at BC Ferries; w/chair available from Rich and Joanne;
							shopping; re-provisioning; packaging; sorting equipment; washing; sorting boats; rest and recreation

12.9.2.14.1. Experience – What

12.9.2.14.1.1. *Summary of experience*

This was a relatively short, smooth leg. The main concern was the mark on AD's skin.

12.9.2.14.2. Observations of AD

AD was quiet and quite pensive. As long as the relevant moving and handling assistance was given, he was quite capable of transferring and managing daily living tasks.

AD elected to use the field toilet early in the morning, to help with privacy and, as he put it, ensure that his toilet needs did not interfere with the running of the day.

Despite AD's insistence, the mark on his right buttock was becoming more pronounced. Discussions with AD suggested that he was amenable to considering changes to his seat padding. AD was concerned with any padding increasing his seated height.

12.9.2.14.3. Observations of KD

KD tried the winged postural support for one day. KD stated that she felt less comfortable. Other expedition members reported that she looked more up right and that she looked to have a longer stroke. My stroke felt more comfortable when she was paddling using the winged support. I attribute this to KD having a longer stroke. KD agreed that her new posture might take time to get used to.

12.9.2.14.4. Changes and amendments

In the evenings, AD was participating less. He was either going to his tent early to lie on his front, or was lying on his front near the cook site. This seemed to make it very difficult for him to contribute to the daily living tasks such as cooking or expedition tasks such as route planning.

12.9.2.14.5. Express – Feelings

The logistical and organizational issues remained; such as packing and organization of the team tasks. The tension between the faster and slower members of the team continued to be a problem. My concerns were to do with AD admitting that his involvement in the expedition may have to change. I felt happy with AD's and KD's paddling on the water.

12.9.2.14.6. Examine – Detail

My main focus for research during this leg was to discuss with AD his needs with regard to padding on the kayak seat. AD's original padding, made of closed cell foam, was sufficient as long as there was no skin breakdown. The marking and damage left by sitting on a stone had changed the parameters for the cushion. With limited field resources, much of the discussion was concerned with the appropriateness of AD continuing the expedition. Discussions at different times of the day and in different scenarios all ended at the same place: "This is my trip and I want to do it".

In the end, AD agreed to take each leg as it came and to at least accept the idea that he may not be able to undertake all of the project.

I continued my discussion with AD concerning the static nature of his chosen postural support. We discussed the possibility that the static nature of his postural support would exacerbate any skin damage because it fixed the relationship between the seat base and the sea kayak. We agreed that performance and control might be gained from rigidity, however this would increase the need for better skin care.

12.9.2.14.7. Explore – Plans and Design and New Targets

It was necessary to either re-plan the expedition, or develop a range of alternative logistical options to include AD whilst at the same time providing space for him to recover. SP had to keep negotiating with AD with regard to his involvement in the expedition.

12.9.2.14.8. Leg Conclusion

There was a trade off between location in the kayak and creating a solution that was naturally sympathetic to human movement. I recognised that in areas of high performance the integrity of connection between kayak and body is vital. In recreation or expedition there is a benefit to having a more dynamic connection, to facilitate blood flow by the change posture.

12.9.2.15. Stage 4 - Port Hardy to Duncansby Landing 5 Days (Full Team)

Day	Date	From	To	Distance	Accommodation type	Weather	Notes
Stage 4 Port Hardy to Duncanby Landing							
18	Mon 30th June	Port Hardy	Shelter Bay	30kms/18.5 mls/ 16nm	Camp - hidden cove; regularly used camp sites in woods; limited cook sites; sandy beach; no water	Rain and wind from SE all day	Across Queen Charlotte Sound through God's Pocket and the Deserters Group of islands
19	Tues 1st July	Shelter Bay	Wilkie Point	27kms/17m ls/ 15nm	Camp – sandy beach; previously used sites in trees; cook-site long way from sleeping site; no water	Drizzly rain and southerly winds; easy paddling but challenging camping	Sea otter experience in Southgate Island group; exposed coast to westerly swell; dense vegetation, sandy beaches and small foreshore – limited campsites

Day	Date	From	To	Distance	Accommodation type	Weather	Notes
20	Wed 2nd July	Wilkie Point	Duncanby Landing	40kms/25mls/ 22nm	Camp on dock at Duncanby Landing – good availability for trolleys for Adi and Karen	Light southerly winds and small swell off Cape Caution	Saw whales off Tie Island in Irving Passage; easy passage round Cape Caution; had to get AD to dry, warm conditions as pressure sore deteriorating
21	Thurs3rd July	Duncanby Landing		None	Camp on dock	Rain and low cloud all day	Rest day whilst decisions made about next stage and AD's care plan
22	Fri 4th July	Duncanby Landing	?	?	?	Rain most of day	Team (minus AD, PG and FP) continues north;

12.9.2.15.1. Experience – What

12.9.2.15.1.1. *Summary of experience*

This was a short dash in damp conditions. The team had a friendly but intense experience with a sea otter who chased both AD and KD. This was a fun event although could have had serious consequences. To stay upright while he played with the sea otter, AD had to throw his head across, creating a scoliosis and head tilt to maintain his balance.

The large swell on the open crossing was interesting and enjoyable. The conditions presented a relatively low sea state despite the large but gentle swell.

KD was willing to accept help in disposing of her human waste, and utilised the field toilet in the same way as a Long Drop. However, KD excreted onto a large piece of kelp, which was then dragged by other team members down the beach to be washed away by the tide. All team members burnt their toilet paper and either excreted below the tide line or used a cat scrape when above the tide line or on dry land to conceal their excrement.

12.9.2.15.2. Observations of AD

During the leg AD's wound developed. The damp conditions and continual pressure were not helping. I discussed with AD his plans for the rest of the expedition. Initially he suggested that it was fine and that he could just continue. During a particularly damp and wet evening I managed to get AD to admit that the wound was deteriorating and that he would need to take a full break from the expedition.

A range of foam samples were donated in Port Hardy to make ad hoc seat cushioning for AD. 30mm slow return foam was used for a day but proved to be too high, making it difficult for AD to locate his pin into the locating slot behind his seat. The additional height also made it more challenging for AD to paddle, as he felt that his centre of gravity was higher. This was fine during calm conditions, but was a real challenge during more dynamic conditions above flat calm.

Thermarest (inflatable seat pad) was also considered as a seat cushion. This increased AD's centre of gravity, but only by approximately 15mm. Whilst this allowed AD to locate his locating pin, he suggested that the air-filled seat pad felt too spongy. Without any consultation, he decided to deflate the Thermarest pad. The following day the sore covered a larger area and seemed as if it may have deepened.

12.9.2.15.3. Observations of KD

KD was beginning to feel happy with the new winged postural support. She insisted that the foam postural support was kept with us as a back up. The gel cushion (from a Jay protector) was working well. The dynamic nature of KD's posture was evident, as the winged postural support, like her previous solution, allowed her to be 'a fidget'. The constant re-positioning during the day, whilst being slightly interrupting to the paddling was likely to be beneficial to her overall skin care.

12.9.2.15.4. Changes and amendments

AD was taking little or no part in the cooking or daily living part of the expedition. He was experimenting with packing out his human waste, involving packing his waste into a black bin liner that was then stowed on the deck of the sea kayak. This was unpopular with the down-wind members of the team.

12.9.2.15.5. Negotiations and re-planning at Duncansby Landing

This was an unplanned stop. With realization by all, including AD, that AD's wound was getting worse, a significant amount of re-planning was required for the next legs of the expedition. The re-planning involved the re-negotiation of all of the team's expectations from the expedition.

12.9.2.15.6. Express – Feelings

At the end of this leg I was relieved to get perhaps our largest open water crossing achieved without incident.

During this leg of the journey I felt disappointed and frustrated that AD was having to curtail his involvement in the expedition and that the tension between the team members was now running high. I felt that the team was concerned that AD's injury would curtail their involvement in the expedition.

At the end of this leg I felt mentally exhausted from the re-negotiation of the team task and individual priorities. The challenge was to keep the team together, by ensuring that all of the members were able to have their personal needs and aspirations met. This was important since the expedition was only partially sponsored. With team members adding a significant personal financial contribution to the total costs, their feelings and aspirations were perhaps more important than if they were just expedition members.

I felt frustrated that it was not possible to run a fully professional expedition to support the research. However I felt it would be an unlikely extravagance to gain full financial support. In some ways this felt like a more appropriate format, bearing in mind the highly unlikely opportunity that inclusive expeditions could be able to attract more funding or resources in the future. Low cost solutions therefore felt appropriate.

12.9.2.15.7. Examine – Detail

The needs of the team and AD were at odds. A logistical solution needed to be found.

Now was a good time to let KD settle in to the new postural support.

AD needed to take rest from sitting and paddling. During the next stop SP and AD went to a local hospital to get a judgement on the skin care problems.

AD elected to rest for the next leg of the journey, to Shearwater, thanks to prior planning and discussion with BC ferries. The captain of the Queen of Chillowack agreed to make a specific stop to pick up AD and drop him off at Shearwater (our next scheduled stop), which is a standard stop for BC ferries. To allow AD to remain on his front for as long as possible, AT and TT volunteered to stay behind to help provide daily living support for AD.

12.9.2.15.8. Explore – Plans and Design and New Targets

I realised it was important to provide options to participants in order to improve their comfort with new equipment.

The foam and compliant gel combination seemed to work well.

Seat cushion height and sense of stability were linked.

12.9.2.15.9. Leg Conclusion

AD was able to participate in this leg of the journey to the detriment of the condition of his skin and the team's faith in his ability to complete the journey without serious injury. Plans were made to enable AD to take a rest from the next leg. This involved new roles for other members of the team, changing the team dynamic and creating two teams in two separate locations. Maintaining AD's involvement in the project did not seem likely, and it was only due to the prior planning and negotiation with BC Ferries that a ‘Plan B’ could be brought into action.

12.9.2.16. Stage 5 Duncanby Landing to Shearwater - 5 Days (AD resting at Duncansby Landing, supported by two team members)

Day	Date	From	To	Distance	Accommodation type	Weather	Notes
Stage 5 Duncanby Landing to Shearwater							
23	Sat 5th July	No record	No record	No record	Camp	Intense Rain	None taken
24	Sun 6th July	No record	No record	No record	Camp	Intense Rain	None taken
25	Mon 7th July	No record	No record	No record	Camp	Intense Rain	None taken
26	Tues 8th July	No record	No record	No record	Camp	Intense Rain	AD's team picked up by BC ferry "Queen of Chilliwack" off Cow island, went to Shearwater
27	Wed 9th July	Shearwater		Planning day	Camp	Hot and clear day	Decision day about next stage; preparing for leaving and

Day	Date	From	To	Distance	Accommodation type	Weather	Notes
							logistics for meeting in Prince Rupert or Alaska

12.9.2.16.1. Experience – What

12.9.2.16.1.1. *Summary of experience*

The paddling team continued without AD, AT and TT. The weather and conditions deteriorated for four days. No research was gained during this leg with regard to postural support. Clothing solutions selected by KD proved to be of real success at this point. The total waterproof trousers, heel pads and hooded paddling smock all proved to be a real success, as she reported to be dry-skinned all day despite the sitting position and the intense rain and spray. The able-bodied paddlers amongst the team who had chosen the PU clothing solutions suggested that they were less comfortable at this stage. All members of the team were feeling the cold.

12.9.2.16.2. Observations of KD

KD seemed to be managing well now with all aspects of the paddling. The cold was a problem and re-warming at night was an issue. A hot water bottle to re-warm legs and the area of her body below the level of injury seemed to be successful. In simple terms this seemed to bring up her core temperature.

12.9.2.16.3. Changes and amendments

The order of the daily programme and decamping changed, with a greater priority being given to creating shelter. This was previously undertaken at the same time as cooking the evening meal, but KD's tent was now being put up before the cook shelter. During departure from camp the non-cooking team took tents and shelters down, with KD's tent being the last to go down only when KD was ready to be carried down the beach. The intention was to provide as much shelter for as long as possible, in order to maintain her core temperature.

12.9.2.16.4. Express – Feelings

This stage felt like an expedition. The holiday was definitely over. Packing and unpacking wet tents, fighting to keep sleeping bags dry, and feeling the real need to warm up at the beginning and the end of the day prior to any lifts made the experience feel very intense.

12.9.2.16.5. Examine – Detail

The team responded well to the change in conditions. A simple change in the daily programme allowed the team to work through some relevantly uncomfortable conditions and achieve the goal of reaching Shearwater in good time.

This smaller team worked well. Issues concerning team logistics and organization were resolved. Moving and handling seemed to work well. The concern was for my own health and safety, as paddling a double with an individual who had little or no capacity to edge the boat was becoming uncomfortable and the condition of my lower back was coming into question.

12.9.2.16.6. Explore – Plans and Design and New Targets Emergency Team Meetings at Sheerwater

Sheerwater provided little comfort. We camped near the car park to the ferry terminal and local diner. Meetings were held in the bar or diner. There was little space for relaxation or informal gathering due to the tight budget.

Following the first meeting, the team wanted AD to go home. I was forced into the negotiation role with AD, who had been excluded from discussions with the rest of the team (on request by the larger team). I put the suggestion that AD returned to the UK to allow his wound to recover. AD refused point blank, suggesting that it was his adventure and that he did not want to be excluded from a journey that he was unlikely to be able to do again. KD down-played the severity of his wound. I managed to get an agreement from AD that he would take a rest from the next leg. I then needed to find a way of supporting AD in Sheerwater so that he did not need to use his wheelchair. I volunteered to stay behind with AD.

I felt that this was a difficult task and the whole matter required some balance, to ensure that AD was able to feel part of the team while the wider team was given sufficient space to be able to express comfortably what they felt. Some of the disability issues felt too challenging to confront directly.

The resolution was put to the wider team and was accepted, but my suggestion that I stay behind was rejected. The following day AT and TT suggested a resolution that a smaller team should continue to Prince Rupert. They would then stay with AD in Shearwater waiting for the next ferry to Prince Rupert, to allow AD more time to rest. AD would then take the ferry while AT and TT would paddle the Outside Route to Kechican.

The whole team would rendezvous in Kechican, with AD leaving message at the ferry terminal of the hotel that he was resting in. AT and TT would take their Outside Route from Shearwater and perhaps rendezvous with the paddling team at the Annan bear sanctuary a short distance from Ketchican.

The resolution seemed to fit all needs and defer the bigger question of AD's departure from the Expedition, whilst at the same time minimising any further damage to his skin.

12.9.2.16.7. Leg Conclusion

There was a need to be flexible with daily programming to allow for individual team needs.

12.9.2.17. Stage 6 – Shearwater to Prince Rupert via Klemtu (AD on Ferry, AT, TT on Outside Route - Independent

Day	Date	From	To	Distance	Accommodation type	Weather	Notes
Stage 6 – Shearwater to Prince Rupert via Klemtu							
28	Thurs 10th July	Shearwater	Ivory Island	27kms/ 17mls/ 15nm	Bivi in old boathouse - campsite had good landing at HT but bound by reefs at LT; horrendous mosquitos; no water	Very hot and clear day; brisk NW in pm	Team minus AD, AT and TT; Dryad Pt, Thorburn Island , Seaforth Channel; saw grey whale in Seaforth Channel
29	Fri 11th July	Ivory Island	Klemtu	48kms/30mls/ 26nm	Camp at Longhouse	Warm, clear day; southerly wind to start; moved to west later; swell developing	Big day; Cecilia Island, Hyde Point, Jermaine Point, Jackson Passage, across Finlayson Channel to Klemtu; saw grey whale off Freeman Point;

Day	Date	From	To	Distance	Accommodation type	Weather	Notes
							v.limited campsites on this section
30	Sat 12th July	Klemtu		Rest day	Camp at Tourist Office - showers and toilets, store and cafe in Klemtu	Heavy rain all day	Visited Longhouse and museum; basketball match in pm; excellent Chinese food in café
31	Sun 13th July	Klemtu	Milne Island	32kms/20mls/ 17.5nm	Camp - protected site at N end of island in trees; no water	Heavy rain all day ; strong north going tide to start with	Split Head to Meyers Passage; v. limited camping in Meyers Passage
32	Mon 14th July	Milne Island	Kayel First Nations fishing camp	64kms/40mls/ 25nm	Camp - camped at unoccupied Indian fishing camp; rainwater in barrel	Rain and southerly wind all day; strong N going tide	Laredo Channel (whale) to Campania Sound,; longest day so far as v.limited campsites;

Day	Date	From	To	Distance	Accommodation type	Weather	Notes
							excellent progress
33	Tues 15th July	Kayel	McCreight Point	30kms/ 18.5mls/ 16mls	Camp – good landing and shallow beach of flat stones; high spring tide so no foreshore; forced bivi on logs as impenetrable forest; no water	Clearing weather all morning; light variable winds and sunshine	PG caught salmon in Casanave Passage; route from Ashdown Island, Squally Channel, Fanny Point to McCreight Point; saw 3 humpback whales in Otter Channel; water on Campania Island
34	Wed 16th July	McCreight Point	Anger Island	41kms/ 25.5mls/ 22nm	Camp – had to clear route of debris from beach to tent sites; no water; sheltered site; flat comfortable sites for 3	Light to moderate southerly winds; weakening flood tide all day; extensive fog over Banks	Principe Channel to Ala Passage; limited camp sites;

Day	Date	From	To	Distance	Accommodation type	Weather	Notes
					tents	Island early on; cleared to sun and squally showers	
35	Thur 17th July	Anger Island	Elbow Point	40kms/25mls/22nm	Camp – mud, barnacles and long carry at LW; water 300m away; comfortable spacious tent sites in trees; good fire	Good weather again; N going tide until late pm	Ala Passage, Pitt Island, Petrel Passage; again very few sites
36	Fri 18th July	Elbow Point	Lewis Island	40kms/ 25mls/ 22nm	Camp/bivi – sites on pebbly beach; sunny NW facing site; no water; easy landing and launching; fire	Hot and sunny day; mod southerly wind and north going tide switched to south going tide and NW wind at end of day	PG caught salmon off Comrie Head; purse-seiners off Comrie Head
37	Sat 19th July	Lewis Island	Prince Rupert	35kms/ 21.5mls/ 18.5nm	Motel - "Inn at the Harbor"	Light winds; deteriorating weather becoming rainy but calm	
38	Sun 20th July	Prince Rupert		Rest Days	Motel – "Inn at the Harbor	Predominantly good weather with sunshine but	Shopping and re-provisioning; meeting

Day	Date	From	To	Distance	Accommodation type	Weather	Notes
						occasional showers	sponsors and press; washing clothes; meeting AD; visits to doctor, chiropractor and massages for several team members
39	Mon 21st July						
40	Tues 22nd July						

12.9.2.17.1. Experience – What

12.9.2.17.1.1. *Summary of experience*

Once again the smaller team set off leaving AD to take the ferry and allow AT and TT to take their chosen ‘more adventurous route’ on the Outside Passage. The team was in good condition, although my back was sore. The routine of decamping, moving and handling, packing, kayaking, then landing and setting up camp was familiar, with team members fitting into a pattern.

12.9.2.17.2. Observations of AD

No observations of AD as he was resting on the ferry and at the hotel.

12.9.2.17.3. Observations of KD

Modifications to KD's seat, including a shortening of the aluminium rods and plastic back stiffener, were holding up well. The gel pad and foam seat remained a good seating solution.

Attending to daily living and toileting seemed to be a lot less stressful for KD, as she was able to choose her routine much more freely.

12.9.2.17.4. Express – Feelings

I felt that I was beginning to be on the edge of the group, as the pain in my back was causing me to withdraw. This was having an adverse effect on my place in the team and my ability to lead the group. Two non-disabled members of the team elected to take on the leadership and field co-ordination role at this stage. This was not formal, but an organic process.

12.9.2.17.5. Examine – Detail

Despite having only one disabled paddler in the group, the small team meant that there was no chance to rest from lifting a person. This meant that the following lifts were mandatory for all team members if the expedition was to continue:

- Lift of KD from tent to cook site
- Lift of KD's double kayak
- Transport of all KD's equipment to boat
- Lift of KD into boat
- Lift of KD from boat to cook site
- Lift of KD from cook site to toilet
- Lift of KD from toilet area to tent

Additionally, the daily living task of cleaning and disposing of toilet waste for KD needed to be attended to.

12.9.2.17.6. Explore – Plans and Design and New Targets

A revision of the moving and handling procedures was undertaken during a period of fine weather that facilitated comfortable group discussion. The following rules were re-enforced:

Calling and communicating – making sure that all members of the lift team understood the calls that were going to be used to start the lift and initiate and undertake the set down

Task – ensuring that all members of the team were able to understand the task, including the start and stop points

Posture management – continuing to use indirect lifts through the use of transits and boat straps to help all members of the lifting team manage a positive posture

Environment – choosing camp sites that were favourable for both camping and moving (it was agreed that this would not always be possible, partly due to the lack of local knowledge)

Timing and planning of lifts – trying to give lifting time to get their 'back moving', and warm up or stretch from a seated position or from sleeping. This could be achieved by trying to ensure that lifts were, where possible, planned rather than undertaken in haste.

12.9.2.17.7. Leg Conclusion

Daily programming should take into account all of the needs of the team, both disabled and non-disabled.

12.9.2.18. Stage 7 Prince Rupert to Ketchikan - 7 Days (AD rejoined the main team; AT and TT on Outside Passage)

Day	Date	From	To	Distance	Accommodation type	Weather	Notes
Stage 7 Prince Rupert to Ketchikan							
41	Wed 23rd July	Prince Rupert	Tree Bluff	20kms/ 12.5mls/ 11nm	Camp/bivi - extensive sandy beach and easy gradient and surface for carrying; plenty of space above tide line; no water	Left in drizzle; but cleared to warm and sunny evening	All team minus TT and AT (who were on 'Outside Passage' route); PR to Metlakatla Venn Pass and into Chatham Sound; SP's back very painful; short and slow day
42	Thurs 24th July	Tree Bluff	Boston Islands	38kms/23.5 mls/ 20.5nm	Camp/bivi – very sandy site so not ideal; idyllically beautiful and short, easy carries; no water	Hot and sunny day again day; light to moderate W-NW'ly winds	Got water at Port Simpson; crossed Portland Inlet by Maskelyne Island; the "Party Beach"

Day	Date	From	To	Distance	Accommodation type	Weather	Notes
							ate two salmon and drank beers
43	Fri 25th July	Boston Island	Cape Fox	22kms/13.5 mls/ 11nm	Camp – east facing site; another beautiful beach, but inconveniently sandy; water from large stream; easy but long carries	Damp, foggy and still to start with; increasing wind from W and SW at end of day	CROSSED INTO THE USA via Tongass Passage, the inside of Sitklan Island and across Nakat Bay
44	Sat 26th July	Cape Fox	Bullhead Cove	39kms/24miles/ 21nm	Camp – excellent beach for launch and landing; awkward carry needed some clearing to access camp sites in trees; no water; good flat and rocky cooking site	Strong southerly winds to start with; poor visibility	Revillagigedo Channel; exposed coast but occasional good harbors and sheltered beaches; got water in Foggy Bay opposite DeLong Islands
45	Sun 27th July	Bullhead Cove	Pot Cover Cove	27kms/ 16.5mls/	Camp - used site so fire-place and some evidence of trash; water some 250m	Southerly wind and light seas	Revillagigedo Channel past Point Sykes and

Day	Date	From	To	Distance	Accommodation type	Weather	Notes
				14.5nm	away; awkward lift up steep bank; dry sites in trees; pebble and barnacle beach but OK at medium high tide		Point Alava; saw whale off Black Island; many fishing parties on water and on beaches
46	Mon 28th July	Pot Cover Cove	Ketchikan	28kms/17mls/14.5nm	Super 8 Motel	Following southerly winds swung round to strong NW'ly headwind impeding speed at end of day	Good progress until Mountain Point when head wind picked up; went to US customs in Ketchikan when arrived; met by SE Exposure Kayaks who had wheelchairs and arranged boat storage; press
47	Tues 29th July	Ketchikan		Rest Day	Super 8 Motel	Sunny, warm and strong winds from	Shopped and re-provisioned;

Day	Date	From	To	Distance	Accommodation type	Weather	Notes
48	Wed 30th July					NW both days	cleaned up gear; huge help from South East Exposure Kayak Co who gave us space, lifting help, logistics support etc; mail plane rides on Wed am for MB, SS, PG, FP and KD; press interviews

12.9.2.18.1. Experience – What

12.9.2.18.1.1. *Summary of experience*

This was an intense leg, with two non-disabled paddlers undertaking a journey on the Outside Passage to make up for their lack of paddling time whilst looking after AD during earlier legs of the journey. With two of the faster paddlers gone and lighter loads, the team seemed to be paddling at a much more even pace. Personally, my back was beginning to feel the strain of paddling with KD, despite her being more upright.

12.9.2.18.2. Observations of AD

These were limited due to management of SP's personal injury.

12.9.2.18.3. Observations of KD

These were limited due to management of SP's personal injury.

12.9.2.18.4. Express – Feelings

A painful lower back meant that some days of this journey became about pain management. AD started to take some responsibility for looking after his skin, and tried a number of foam and inflatable padding solutions. I did not feel it was the appropriate time to be undertaking this. I felt that it was important for AD stop this journey as soon as possible, as I had major concerns its appropriateness for him.

For myself I felt that I needed to find a way of being able to participate in the team whilst dealing with the pain.

12.9.2.18.5. Examine – Detail

Much of the detail of this leg was lost, as my role was pure survival and maintaining my personal ability to contribute to paddling and assisting with the daily living tasks.

I spent much of my non-paddling time dressing AD's wound to try to reduce the level of damage to his skin. The wound continued to deteriorate. AD seemed to be constantly cold and had a number of failures of his catheter and bag, which meant that his sleeping bag was soiled and wet. Discussions revealed that he was not sleeping well. He was in a tent on his own and was cold for much of the night. He still remained adamant that it was his expedition and that he was going to finish the journey now that he has missed a number of the earlier legs.

12.9.2.18.6. Explore – Plans and Design and New Targets

The main plan was to reduce any moving and handling. This meant not taking rest days, to ensure that any lift was for a reason. Although we were ahead of schedule, both KD and AD suggested that they did not want to take a rest day in the wilderness without their wheelchairs, as it would mean that they would be immobile and completely dependant on the team to transport them. We agreed to push on with as few rest days as possible.

12.9.2.18.7. Leg Conclusion

This leg was limited by my injury. There was a constant need to re-evaluate moving and handling.

12.9.2.19. Stage 8 Ketchikan to Petersberg - 6 Days (AT and TT to rendezvous with main team on day 5 of this leg)

Day	Date	From	To	Distance	Accommodation type	Weather	Notes
Stage 8 Ketchikan to Petersberg							
49	Thurs 31st July	Ketchikan	Caamano Point	34kms/21mls/ 18.5nm	Camp – good pebbly beach with little sand; long carry at low water; water from big stream	Moderately S'ly wind and strong N going spring tide; drizzle later in day and evening	Arranged for Kim Kirby (SE Exposure) to take wheelchairs to Petersburg; left in afternoon, Tongass Narrows, Point Higgins, crossed Behm Canal to Caamano Point ; Adi capsized near end of day on a rogue wave
50	Fri 1st Aug	Caamano Point	Meyers Chuck	30kms/18.5mls16nm	Bivi – undercover of basketball court in disused school; water on dock; carries effected using carts	Dreich day of drizzle and fog; light variable winds;	Niblack Point, Ship Island, Three Island to Meyers Chuck;

Day	Date	From	To	Distance	Accommodation type	Weather	Notes
					and barrows from dock	variable slow tides	Barry of Tacquan Air gave ‘fly past’ in morning; good sites available and water up coast but lots of log jams; met Garry and dog from Seattle rowing back from P’burg to Seattle
51	Sat 2nd Aug	Meyers Chuck	Frosty Bay	15kms	USFS Cabin – very difficult landing on steep and sharp rocks; boats tethered to floating dock overnight; dry comfortable cabin with oil stove	Drizzly overcast day with S’ly winds and N going tide	Given loads of fish – fresh and smoked before we left; rounded Lemesurier Point, followed Ernest Sound past Union Bay, Vixen Point, Seward Passage.

Day	Date	From	To	Distance	Accommodation type	Weather	Notes
							Kim Kirby landed plane off Deer Island on way to P'burg with chairs; v. limited sites around Seward Passage
52	Sun 3rd Aug	Frosty Bay	Anan Bay	17kms/10.5 mls/9nm	USFS Cabin – bear boxes for food; very easy access and egress from beach; strict rules for bear do's and don't's; pit toilet; water from observatory HQ; oil stove and oven; boats tethered to floating dock	Fairly dry day	Half day paddle to Bear Observatory; saw plenty bears at mouth of river; ate halibut donated by expedition boat
53	Mon 4th Aug	Anan Bay	Berg Bay	22.5kms/14 mls/12nm	USFS Cabin – bear boxes for food; dry and comfortable; pit toilet; water nearby; oil heater; easy access and egress as	Return to settled weather	Visited observatory in am; excellent black ad grizzly bear sightings;

Day	Date	From	To	Distance	Accommodation type	Weather	Notes
					cabin 25m from shore		met up with TT and AT again; half day paddle to Berg Bay
54	Tues 5th Aug	Berg Bay	Little Dry Island	50kms/ 31mls/27nm	USFS Cabin – beautiful setting on delta; very easy access at HT only – v. short walk to cabin 10m max; easy to slide boats on marshy vegetation; would be inaccessible at LT; wood stove; no water	Warm, sunny and windless day; favorable tide into Little Dry Island	Fabulous paddle across Stikine Delta with views of Stikine Glacier and Devils Thumb; v. tricky area for tides – needs planning
55	Wed 6th Aug	Little Dry Island	Petersburg	42kms/ 26mls/ 22.5nm	Tides Inn Motel	Clear, sunny and warm; water cold from glacier; strong headwind in pm	Boats left by arrangement at float plane hanger;
56	Thurs 7th Aug	Petersburg		Rest days	Tides Inn Motel		Usual re-stocking and repacking; cleaning gear etc
57	Fri 8th Aug						

12.9.2.19.1. Experience – What

12.9.2.19.1.1. *Summary of experience*

There was a good camp routine and boats were being well packed. The main challenge came from the number of lifts, as the small team now had a repetitively high ratio of disabled to non-disabled participants. AD insisted that he was fit to continue. SP spent much of his non-paddling time attending to AD's needs. The rest day at the bear sanctuary required long lifts to help ensure that both KD and AD were involved in the group activity. Special permission was given by the wardens at the sanctuary to utilise the double kayak, to reduce lifting. It also meant that KD and AD could remain in the double kayak through bear territory to within ½ mile of the observation point. From there a piggy back approach was adopted to get both KD and AD down the small trails and over challenging terrain. This was a trying and challenging process. All members of the team were able to observe both black and brown bears in the wild, during which time AT and TT arrived from their journey around the Outside Passage.

12.9.2.19.2. Observations of AD

AD was paddling well. He looked tired but well when on the water. When on dry land he was a little despondent dealing with his skin issues. The sore was growing each day, and we were going through three or four dressings per day. A doughnut was constructed in the foam cushion (closed cell foam) to help relieve the pressure. Despite this and attempts to round the edges of the doughnut, the sore was getting worse.

Conversations continued with AD with regard to his continuation of the project and the possibility of him taking antibiotics as a precautionary measure to help reduce the possibility of infection.

12.9.2.19.3. Observations of KD

KD used a change in sitting angle to deal with changes in condition. The velcro was becoming worn on the waistband of the support.

KD elected to post the foam back support to the UK and now totally invested in the winged support.

The use of a back strap behind the support allowed KD to develop a more upright posture.

12.9.2.19.4. Express – Feelings

My back was becoming very painful and I woke each day with extreme discomfort. It was becoming a real challenge to dress. I was starting to become worried about what was wrong with my back, but I felt that it was inappropriate to share this with other members of the group. Once I got moving my back seemed to get better, for a while. The constant lifting and carrying was getting to me. Kayaking flat, with little or no edge was draining.

I had real concerns over the viability of the project, but felt that we were so close to the objective that it would be difficult to challenge the momentum of the team. AD was conscious of the damage that he was doing to his buttock and seemed to be aware of the potential clinical implications of full thickness pressure sores. He remained adamant to continue, saying “non-disabled people have the right to lose a toe to get to the top of Everest, so what is the difference here?”

12.9.2.19.5. Examine – Detail

The change in the team (with AT and TT rejoining) meant that there were more resources to undertake lifts. The change in team meant that there was a need to re-assess the group roles, to help share the work load and allow the team to reform. There was significant resistance by AT and TT to participate in group lifts using the boat straps. Both insisted that they would carry their boats to the shore using a bow and stern method, and felt reluctant to be involved in the group manual handling.

12.9.2.19.6. Explore – Plans and Design and New Targets

The main objective for the remainder of the expedition was to complete the journey without any further injury to any of the team members. From my own perspective I felt that the second objective was to manage the closure of the team and the end of the project. I remembered feeling that there should have been a marching band or big celebration in Calcutta when we reached the end. There was not, only a truck to put the equipment in and a series of tasks to achieve. Any celebration or time to reflect on the success of the journey as a team was made by the team itself. With the tensions over team roles once again re-emerging and the desire of some of the team members to push on I did not feel that there was going to much reflection and that the time for celebration would be passed over as each team member moved on to their own next task, outside of the expedition project.

12.9.2.19.7. Leg Conclusion

Waist bands needed to be removable to help with repair or replacement of velcro damaged in sand and salty conditions.

12.9.2.20. Stage 9 Petersberg to Juneau - 6 Days (full team)

Day	Date	From	To	Distance	Accommodation type	Weather	Notes
Stage 9 Petersberg to Juneau							
58	Sat 9th Aug	Petersburg	Grand Point	24mls/21nm/ 18.5nm	Camp – excellent dry spacious site in trees; very rough beach loads of goose barnacles; no water; lots of black fly	Hot, clear and sunny, light winds in am but stronger N'ly wind in pm	Crossed Wrangell Narrows; Frederick Sound between Sukoi Islands to Cape Agassiz, Thomas Bay (interesting tides)
59	Sun 10h Aug	Grand Point	Robert Island	25mls/22nm/ 19nm	Camp – excellent site although limited space for tents on foreshore; steep and shingle-y beach so good landing site and short carry; no water and no bears	Settled sunny weather again – very hot; light winds only	Frederick Sound, Farragut Bay to Bay Point; Lunch at Bay Point where we watched 4 otters in water, Cape Fanshaw (lots of sea-lions) to west side

Day	Date	From	To	Distance	Accommodation type	Weather	Notes
							Whitney Island;
60	Mon 11th Aug	Robert Island	Point Lookout	30mls/ 25nm/ 22nm	Camp – evidence of bear activity; campsite in trees, dry and flat; shingle beach and very long carry at LT; water from small stream	Hot, clear and sunny weather; no wind	Stephens Passage past Twin Islands, Sunset island, Windham Bay; excellent sightings of 3 groups of humpback whales, feeding and tail slapping; found ice berg and drank Baileys on ice
61	Tues 12th Aug	Point Lookout		Rest Day		Increasingly grey and overcast day and some drizzle	Cleaned hulls of kayaks of oil (from P'burg); saw porcupine and baby and chipmunks

Day	Date	From	To	Distance	Accommodation type	Weather	Notes
62	Wed 13th Aug	Point Lookout			Camp – good beach; steeply shelving but short carry; very rocky at LW however; good camp sites above foreshore; no water	Generally dry but some drizzle later on; light winds	
63	Thurs 14th Aug	Point Lookout	Juneau	12kms	Douglas – arrived just before dark, all cold and wet; bivied in large garage belonging to local boat owner; hot water available and we sent out for pizzas	Our first day of heavy rain for weeks; cloud right down; tides against us in Gastineau Channel	Taku Harbor, Grand Island, Marmion Point, Gastineau Channel; navigational error early in day added a couple of kms to journey; keen to finish and avoid another wet night

12.9.2.20.1. Experience – What

12.9.2.20.1.1. *Summary of experience*

The full team pushed on for the finish, almost in a frenzy to get to the magical finish line. Both KD and AD were very happy in their boats.

The tent poles were beginning to break.

During this leg I was able to paddle solo for two days.

12.9.2.20.2. Observations of AD

AD's skin abrasion had grown into a full pressure sore and it was only through real belligerence that AD continued. The team did not want him to continue and nor did I. Most of my duties during this leg were as nurse to AD, to dress and clean the growing wound on his right buttock. Dressing and cleaning took up to an hour every morning and afternoon. Catheter problems meant that AD also had real issues with personal hygiene. He changed his catheter make without letting anyone know. AD's skin issues were also made worse by the catheter problems. SP had long discussions with AD about the need to take precautionary antibiotics.

12.9.2.20.3. Observations of KD

KD, although more upright than I had seen previously, was still slumping to deal with extreme conditions, especially those where there was a beam or quartering sea.

12.9.2.20.4. Express – Feelings

For me now the efficacy of research in expeditions with lead users was in real question. The belligerent nature of the users seemed to be at constant odds with the need to take a truly objective look at the real needs.

Gaining access to the outdoors at any cost has always been a part of adventure and there are those explorers who have paid the ultimate price: Scott died, Rhienholt Mesner lost his toes, and countless others have damaged themselves during adventure. I started to question why it should be any different for disabled adventurers.

12.9.2.20.5. Examine – Detail

Being able to paddle solo for two days allowed me to more closely observe the paddling action of KD and AD, but most importantly take the pressure of my increasingly painful back. For the rest of the time my role as observer was now turned into AD's nurse and medic.

Ending the project was my prime concern, keeping the team together sufficiently long to be able to clean and repair the equipment, and write up reports.

12.9.2.20.6. Explore – Plans and Design and New Targets

I recognised the need to ensure that tests and trials can be undertaken in solo boats to allow for better observation. The need now was to get the team well and ensure that the needs of the commercial and non-commercial sponsors were met. The latter involved the generation of publicity and telling the story.

Additionally there was a need to now take the practical lessons learnt into:

- The development of equipment
- The development of training for instructors
- The development of new formats for field trials.

12.9.2.20.7. Leg Conclusion

The postural back support provided better control when angled. Future tests and trials of postural supports should be undertaken in solo craft, rather than from a double.

12.9.2.21. Overall Reflection

12.9.2.21.1. Experience – What

The expedition was a success as it revealed the context of sea kayaking and provided me with a real sense of the practical design issues that need to be addressed to make sea kayaking accessible to intermediate disabled paddlers.

- Daily living
- Clothing
- Seating
- Moving and handling

12.9.2.21.2. Express – Feelings

I was slightly disappointed about this expedition. I found it more physically challenging than I would have wanted. I found the tension between my desire to focus solely on research and my leadership requirements a challenge to manage. Finally, being in the double of a sea kayak with someone who was unable to respond to the sea conditions effectively for the majority of the journey was a real challenge. I initially found this surprising, as I have undertaken extended journeys in tandem craft previously, but recognised there may well be a difference in terms of vessel type and duration of expedition.

12.9.2.21.3. Examine – Detail

From an organizational and planning perspective, it was clear that delicate programming and team or group management was required, to ensure that basic expedition logistics were maintained as well as ensuring that the balance between time on task and rest time was maintained. Additionally, ensuring that all team members were meaningfully involved was essential. In a day-to-day setting this might be expressed as ensuring that the individuals do as much as they can and that the supporters or 'carers' needs are also looked after, whilst ensuring that all the tasks are achieved in a safe and sustainable manner.

My own personal leadership was not the best it could have been during this expedition. I attribute this to my change in role at the last minute and the change in the condition of my back during the expedition, as a result of paddling a double and being involved in all of the lifts.

From an equipment development perspective the relationship with two lead users was valuable and interesting. Both KD and AD utilised their adaptations successfully during the expedition. KD took time to take up the winged version that had been prepared for her. AD's postural support had been strengthened for the expedition, but the main concern for him was the development of a pressure sore, and the logistical and programming concerns which were revealed as a result of this critical incident.

The length of the study did not help me to understand the practical seating issues any better, however it did reveal some of the environmental issues with regard to the use of equipment, illustrating how abrasive the sand, salt and movement combination are.

The way in which clothing is used in a range of conditions also seemed to be a large factor. Layering, as in any outdoor sport was vital. Any seating solution should be able to cater for changes in layering.

12.9.2.21.4. Ethics

There was a clear ethical dimension to the expedition which had been resolved during the planning and training for expedition leg, to ensure that all members of the team were primary risk takers during the expedition.

During the expedition two significant injuries occurred which created logistical and ethical dilemmas for the whole project team: the development of a pressure sore by AD as a result of sitting on a stone, and the development of damage to the researcher's lower back resulting in significant pain, temporary loss of sensation and long term reduction in range of movement in the lower back.

As a leader it was easier to deal with the first injury to AD. My approach was to ensure that AD was aware of the full extent of the condition of his right buttock and the damage that continuing the expedition was doing to him. It was a simple case of negotiation with him to ensure that he was the primary risk taker, and then mediating between AD and the rest of the team to ensure that the rest of the team understood the risks that were being taken, ensuring that they were at least educated secondary risk takers.

The second injury, which was to myself, was perhaps more challenging. I felt that there was a significant reduction in my ability to lead the expedition during one or two legs due to pain. The pain meant that I withdrew, just to cope with the injury. I believe that my leadership struggle was concerned with my loss of stature within the group, resulting from my last minute change in role, a back injury during a lift. Even though I was in considerable pain and was concerned about the damage I may have done to my back, I chose to continue with the expedition, to complete the expedition task.

Working with two lead users over a long period of time has provided me with the ability to see the way in which the outdoor environment works when individuals are seeking access and meaningful activity. I have noticed that expedition based research where the focus is on one sub-group or individual within a team, as occurred here, may not be conducive to good research. This is because there are dual aims and multiple objectives deriving from the focus and non-focus team members. This takes away from the research and inclusive agendas. Further to this, the conflict between fee-paying participants and research is a difficult one, as the participants needs always come before the needs of the research.

On return to the UK both injuries were dealt with utilizing National Health Service (NHS) services. When I was able to visit AD in hospital I found that nurses had chained AD's wheelchair to the radiator across the room, with the key tied to the window sill. AD said that it was not fair that he had to stay off his chair for such a long time and did not think that it was necessary. The clinical staff in the SCI ward clearly thought otherwise.

My back and self confidence took perhaps a little longer to re-build. Since the expedition I have still not been able to access a sea kayak with any comfort.

12.9.2.21.5. Explore – Plans and Design and New Targets

The next round of research should be shorter and involve a professional team of outdoor facilitators or coaches to undertake the coaching. The technical and research elements to the project can then be focused upon.

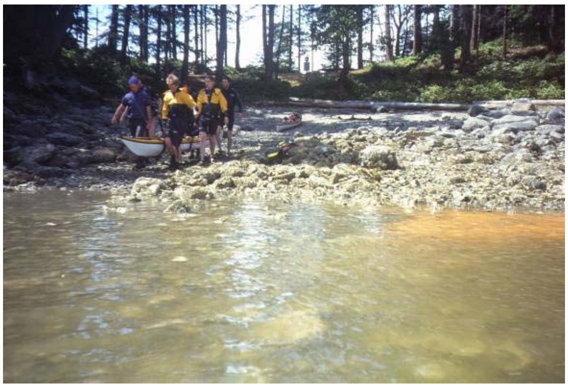
I learnt more about my changing role than anything else during this expedition. I started as a researcher, then had to combine this with being team leader, before becoming chief nurse and carer whilst struggling with my own personal health. It seemed that caring and leading do not mix well, as the leader becomes too involved in the situation to be objective.

This led me to consider the nature of inclusive expeditions with lead users, who by nature may well be task orientated at the possible expense of others. Working with critical rather than lead users may allow for a more staged development of resources and a relationship that is more conducive to undertaking meaningful research.

If it is possible to also involve the lead users from the research studies to date then the new critical users will be able to learn from the lead users directly, allowing for the potential transfer of knowledge within the community.

There was a link between this study and study 5, in that coaches thought their coaching would need to be altered to be inclusive, when actually it was more about the planning, organisation and access requirements.

12.9.2.22. Images



12.9.3. Conclusion

Study 7 gives a reflection on the performance of two lead user kayakers with SCI in a field expedition setting and the efficacy of two prototype seating solutions. Observation and a reflective log were utilised.

The expedition was ecologically sound, minimizing disturbance to marine and terrestrial wildlife while also supporting local trade. It provided a good opportunity to trial the field toilet on an expedition, which was successful in further reducing our impact.

The team did not form smoothly in the UK, with only eight days of training in coastal sea conditions plus pool safety sessions. It was also too small during the expedition to effectively cope with the tasks. In particular, there was a high volume of care requirements, including carrying. Non-disabled team members became increasingly fatigued and keen to have carry-free days, but this was at the expense of the disabled team members who then had no access.

One member of the team was elected as photographer, to share images upon return. Similarly I learnt the importance of taking responsibility for personal equipment, keeping it ordered, considered and minimalist. It was also useful to make international contacts, which were generated prior to departure and called upon when situations arose.

The expedition proved extremely useful in providing information about planning, environment, task, standard and adaptive equipment, and individual performance. Due to changes to my intended position in the team and more immediate issues with team members I could only gain directional feedback concerning equipment, rather than the intended conclusive feedback.

The directional feedback showed that the two equipment solutions worked well, although it took time for the one participant to attempt to adopt one solution.

12.10.Study 8: North Uist, Outer Hebrides 24th-31st July, 2004

12.10.1. Introduction

The following design field trial was undertaken on North Uist, which is one of the UK's top sea kayaking destinations. The trial was a multi agency research project undertaken in partnership with the John Muir Trust and Interventure (a Scottish based charity, which promoted inclusive outdoor activities and ran between 2001 and 2004), which provided logistical and insurance cover for the field and kayaking elements. The study took place over six days and was run from a low cost bunk house next to a sheltered sea kayaking venue, within easy access of more challenging conditions (weather permitting).

Each participant made a contribution to the living costs of their involvement in the field trial. All participants took it in turn to cook meals for the group, which were eaten in a communal setting. Additional coaching support was funded and organised by Interventure. Technical resources, including materials, tools and a mobile workshop were supplied by Equal Adventure.

Research projects were undertaken as part of a doctoral training programme supported by the Brunel Institute for Bioengineering, and are presented as part of this thesis.

Safety management, daily staff briefings, weather reports and float plans were discussed during a co-ordinated staff briefing.

12.10.2. Aim

To re-evaluate the efficiency of three postural support solutions for spinally injured sea kayakers, within a coached intermediate environment, based on community rather than expedition participation, in order to inform an iterative design process.

12.10.3. Participants

The total number of participants on the project was seventeen, of which there were five participants who volunteered to partner with the researcher to evolve bespoke seating solutions to facilitate their involvement in sea kayaking.

12.10.4. Operational considerations

Operational considerations such as moving and handling, rescues, and organisation of coaching were drawn from previous studies.

12.10.4.1. Venues

Access and egress points were selected on the basis of access to slipways, to minimise moving and handling and to increase the independence of mobility impaired paddlers.

Heavy duty doormats were used to act as a sliding surface, enabling participants to transfer into their kayaks independently on flat concrete surfaces at the top of a slipway and then slide independently down a static conveyer-belt into the water (seal launch). The doormats acted as a protection to the boat and reduced the friction, thus making access and egress from the sea easier regardless of disability.

12.10.4.2. Additional equipment

The following standard outdoor equipment was sourced by Interventure and utilised to assist with the inclusion of the disabled participants in the group:

- Tarp
- Thermarest
- Sling
- Boat sling
- Bespoke spray decks to fit over AQUABAC
- Mobile workshop
- Tools

The following tools were supplied by Equal Adventure and packaged in such a way that they could be used by the waterside during the course:

- Screwdrivers
- Hammer
- Padsaw
- Jigsaw (electric)
- Kneeling mat
- Trellis
- Black and Decker workmate

- Panel saw
- Mole grips
- Pliars – bullnose
- Pliars – longnose

12.10.4.3. Materials/Specialist Equipment

The following materials were donated by Equal Adventure to facilitate the fitting and development of bespoke seating solutions:

- Foam
- Natural PU 3 mm
- Duct tape
- Assorted stainless steel nuts and bolts
- Pipe lagging
- Cable ties
- Accessory cord
- Elastic shock cord
- Assorted webbing
- Sale makers palm
- Specialist Equipment
- AQUABAC

- Butterfly
- AQUABAC Spraydeck

12.10.4.4. Logistics and planning

Five participants with SCI were interviewed and observed on a one-to-one basis throughout the week with a view to improving their current seating arrangement in a sea kayak.

12.10.5. Method

An initial interview and observation was held with each participant beside the water, to gain information about their current seating arrangement. Following this, individually tailored adaptations were made to one of three seating designs; carbon fibre hoop, AQUABAC, or Butterfly. The participant then took part in a coached session and tested their new seating arrangement. The process was repeated throughout the week, with adjustments made based on the participant's feedback, until an appropriately individually tailored seating arrangement was found.

The following methods were utilised:

- Field-based data collection tools, in the form of questionnaires, were utilised to assess the seating concepts
- Participant observation was utilised to add depth to the researcher's understanding of the validity of the seating concepts
- Reflection was used to provide an assessment of the field-based data collection tools.

12.10.6. Approach

A deliberately low key and informal approach was taken to allow individuals to settle in. I felt that this was important, as it allowed each participant to have their holiday whilst at the same time contributing to the research project.

I worked with each participant individually, offering them a design solution at the end of each technical intervention, which they then utilised during structured coaching sessions. I was not involved in the coaching and was not able to observe the coaching. I spent my time purely creating jury-rigged equipment by the side of Lochmaddy. I was only able to observe each participant briefly during the last day's kayaking, once I had completed all of the technical interventions to the satisfaction of each of the disabled participants.

12.10.7. Background Information Sent to Participants

12.10.7.1. The John Muir Trust

The John Muir Trust is a leading UK charity dedicated to the protection of wild land for both nature and people. Scottish-born John Muir inspired their name and ethos, as the first person to call for action to be taken to protect wild land, and an instrumental figure in the modern conservation movement.

The Trust was founded in 1983 to safeguard the future of wild lands against development and to promote awareness and recognition of the value of such places. They are achieving this through ownership in over 25,000 hectares of land, with partnerships in a further 50,000 hectares.

The John Muir Trust educates people about the value of wild places through the John Muir Award. It was started in 1997 to offer people of all ages and backgrounds the opportunity to learn about wild places. Through the four challenges of discover, explore, conserve and share and three progressive levels of involvement, it has so far helped over 50,000 people gain an appreciation of such places.

They engage people with wild places through their volunteer Conservation programme. They welcome volunteers to join them on conservation weekends.

http://www.jmt.org/about-the-john-muir-trust.asp

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12.10.7.2. Interventure

Interventure provides and develops opportunities for disabled people to participate in adventure sports and outdoor activities. They dissolve physical and social barriers to inclusion by working closely with existing outdoor and adventure sports organisations, improving health and quality of life for all involved.

Activities range from handcycling to sea kayaking, usually based in Scotland, and primarily tailored for people with physical disabilities. They also run occasional international expeditions with the aim of providing integrated opportunities to explore a variety of challenging wilderness environments.

They are a registered charity (SCO31889 by constitution), with activities supported by fundraising and volunteers.

Interventure was formed in 2001 by Karen Darke with the aim of developing opportunities for any person to experience adventure and exploration, particularly in Scotland. Paralysed in a rock climbing accident, Karen sought to find new ways to continue her enthusiasm for outdoor and wilderness environments, recognising the logistical and financial barriers to inclusive outdoor sports, and consequently formed Interventure.

http://www.equaladventure.org/interventure/overview.htm

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Visited 31 January 2009 11:59:42

12.10.7.3. Equal Adventure Developments (EAD)

EAD is a development organisation which aims to improve access to the outdoors for people with disabilities through equipment design, training and resource development. We have a range of areas currently undergoing field testing and adaptation. These include: The AQUABAC, The Field Toilet and Outdoor and active clothing.

12.10.7.4. The AQUABAC II

This is a practical design project, building on the first AQUABAC. The aim here is to develop a support system for intermediate and advanced level sea-kayakers with spinal cord injuries, as part of a PhD project supported by Brunel Institute for Bioengineering.

12.10.7.5. The Field Toilet

This is another practical design project which started as a result of the Ganges 1998/1999 expedition, and was further developed on the Canada to Alaska inclusive kayaking expedition in 2003. The aim is to develop a highly portable modular design solution, which is able to be used by people with a wide range of abilities, thus providing a solution which promoted independence whilst being hygienic and eco-friendly.

12.10.7.6. Outdoor Clothing

This is a current research project in partnership with Aguille Alpine which aims to provide two specific ranges of clothing; one is a range for outdoor centres, and the other is for the personal intermediate and advanced outdoor athletes.

12.10.7.7. Getting Involved

Please fill out a questionnaire if appropriate, and try to be as open and honest when giving feedback during one of the 'reviewing' exercises on the trip. Equal Adventure Developments take the factor of confidentiality very seriously and would like to state that any information provided in the form of 'feedback' will be treated in the strictest confidence and if necessary, in line with our policy on Data Protection.

Your ideas and opinions are always valid, so please do call or e-mail us with your thoughts after the trip – all projects are open to adaptation.

12.10.8. Design Interventions

12.10.8.1. MK

MK was originally going to be part of the Canada to Alaska sea kayak expedition team and had wanted to be involved in previous parts of the research project. However, external commitments and distance precluded him from being included any part of the research to date apart from the initial interviews (study 4).

This can therefore be considered to be the first fitting or collaborative design research exercise.

MK has a L1-3 (complete at L1) spinal cord injury following a fall whilst climbing.

Past kayak experience involved "wobbling around" in the boat and not being able to brace his legs on the side of the kayak cockpit. MK had more experience in a canoe than in a kayak and graded himself as being somewhere between a novice and intermediate. MK hoped to progress to become an advanced paddler within a couple of years.

MK wanted a support that would give a more secure sitting position in the boat, to enable him to control his leg positioning. He also wanted it to be transferable between boats.

12.10.8.1.1. Design solution

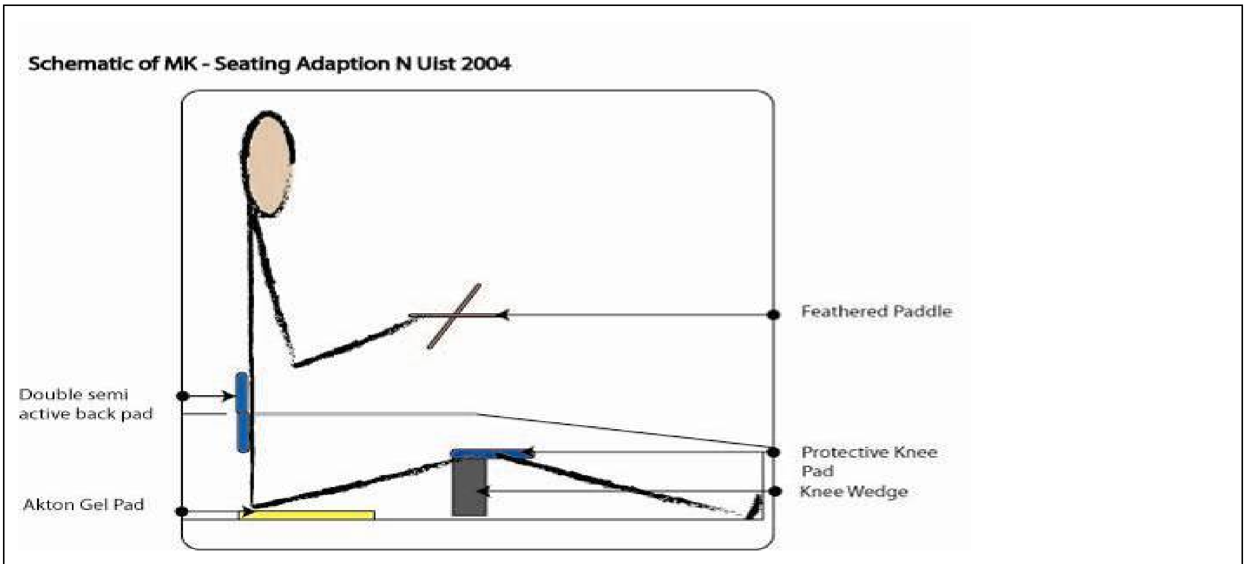
With a high level of trunk control due to the low level of MK's spinal cord injury, the following design system was agreed:

The fitting with MK was quick and efficient. I feel that this was due to our long-term expedition relationship, as MK was a member of both the Israel and

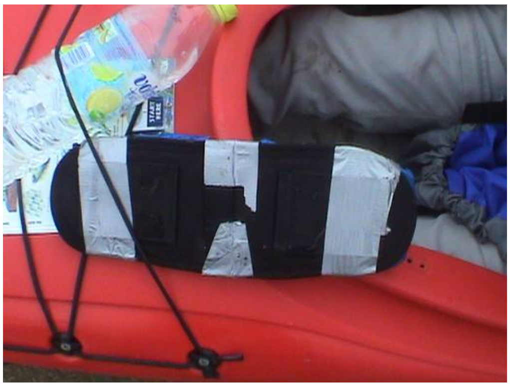
Ganges expeditions, and he had provided design feedback as part of the development of the AQUABAC system whilst I was working at BIB and then more latterly DFL.

Design issues were dealt with from toe to head. From my perspective the most technically demanding or problematic area was the creation of the back, or lumbar, support. The detailed design of this element fluctuated in terms of the height and amount of dynamic or active lumbar support requested by MK. I felt happy to focus my attention on working on this area with an active, springy element, as MK reported full sensation above the line of his posterior iliac crests. Additionally, no part of the proposed active lumbar support was directly in contact with the skin and they were padded to prevent abrasion.

Without support MK's pelvis had a posterior rotation. The most successful solution for the back rest supported MK's pelvis, rotating it into a more neutral position. The back rest located into the standard fixtures of a P and H sea kayak, creating a highly portable system.



	Cross strapped lumbar pads were stacked vertically using ratchet buckles. Natural PU sheet was shaped and inserted to create a structure for increasing lumbar lordosis
	
	Pronounced lumbar lordosis and higher than usual lumbar support

	
	Accessing the cockpit
	Adding thigh or knee protection pads

12.10.8.1.2. End of week review

MK found the adjustments a bit fiddly and suggested that if a capsize occurred there would be a lot of debris to collect. MK noted the simple release mechanism to enable a quick exit in the event of a capsize, though he was unable to test this.

It improved security of position, which was his goal, although he wanted to test this further by performing in more challenging conditions.

12.10.8.1.3. Summary of feedback

Make the back support capable of being fitted into the sea kayak prior to getting into the boat, without impeding transfer.

Reduce the debris formed by loose padding in the cockpit. This is especially difficult when in a capsize situation, as the knee-pad and knee wedges may be lost at sea.

12.10.8.2. SH

Details following an informal introduction to seating and the background to the project were gathered by the side of Lochmaddy over a cup of tea. The participant was clearly relaxed and was able to see the context the proposed solution was going to work in.

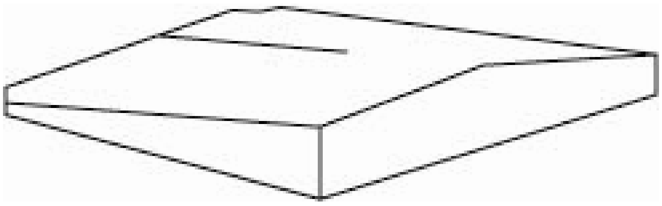
SH reported to be a novice kayaker and have a spinal cord injury at L3/4 complete. She also reported that her posture was reasonably symmetrical, with little or no spasm and no history of skin care problems during daily living or sport. She expressed that she had no concerns over bladder or daily living functions during the time on the water. She also suggested that her living accommodation and daily living arrangements were satisfactory.

SH was fitted out with an AQUABAC and elected to utilise a Capella single P and H sea kayak. SH utilised a spray deck which had been designed to be used in conjunction with the AQUABAC and provided additional room for the elements of the AQUABAC which protruded above the line of the cockpit. The specific design features of the spraydeck were in the cut which allowed for trunk rotation and backward lean.

	AQUABAC in situ with seat removed
	Additional side pads
	Inside cockpit showing jury rig foot protection and support

12.10.8.2.1. Leg control

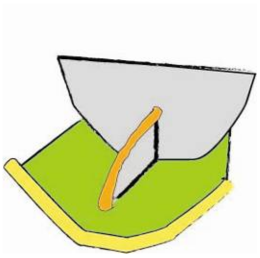
The under thigh pad from the AQUABAC was sculpted to provide a gentle roll-out of each thigh.



Modified under thigh pad

12.10.8.2.2. Foot control

A jury rigged full plate foot rest, ankle protector and divider was created to provide passive location and support to SH's feet.



Jury rigged full plate foot rest, ankle protector and divider

The fitting took one hour. SH then spent the rest of the week using it while paddling with her group and reported she felt she was comfortable in novice conditions. Her coach reported that she participated fully in basic activities, but felt there would be a need to re-address her support if she was going to improve and move towards intermediate level paddling in a greater range of conditions.

This study suggested that the current AQUABAC postural support does work in novice sea kayak conditions. In the end of the course feedback SH reported to feel great comfort and security with the AQUABAC, suggesting that it provided adequate support. SH suggested that the AQUABAC did not need adjustment on or off the water.

12.10.8.2.3. End of week review

SH's responses suggested that the AQUABAC was limited by the fact that you have to remove the kayak seat to fit the AQUABAC into a sea kayak. She suggested that the addition of a chest band for high level support would be an advantage.

Note: Whilst I do not consider this study to reveal large amounts of new data concerning intermediate performance in sea kayaking for individuals with spinal cord injury, I do feel that the data suggest that current off the shelf solutions are adequate for entry level or beginner sea kayaking. From a design standpoint this study suggests that it is possible for any design solution to focus solely on the needs of intermediate level paddlers, rather than having to straddle both groups of performers.

12.10.8.3. PA

This course was the first time that I had met PA. I elected to undertake an informal interview, to help put PA at her ease.

12.10.8.3.1. Informal interview

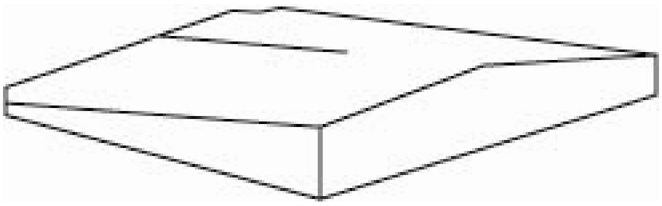
During the introduction I learned that PA had become a wheelchair user as the result of SCI during a car crash. PA explained that during the subsequent treatment and rehab she was told that she had a mild degenerative disorder that was slowly wasting away the remaining control of her body. She suggested that she had a weakness on her right side and that daily living tasks were not a problem in the outdoors.

PA suggested that she was comfortable in the outdoors and in a kayak as she had been a buddy on Backup courses (Backup is a spinal injury charity that supports active lifestyles and utilises outdoor activities as post hospital therapy following

SCI). PA revealed that she felt that she would be comfortable using an AQUABAC as she had used one on Backup courses in an open canoe and was interested in using one in a kayak.

12.10.8.3.2. Leg control

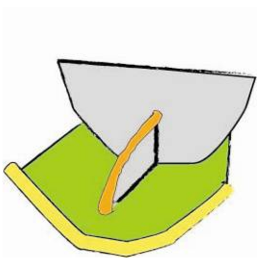
The under thigh pad from the AQUABAC was sculpted to provide a gentle roll-out of each thigh.



Modified under thigh pad

12.10.8.3.3. Foot control

A jury rigged full plate foot rest, ankle protector and divider was created to provide passive location and support to PA's feet.

	Jury rigged full plate foot rest, ankle protector and divider

The fitting took one hour. During the week a total of four pit stops were made which interrupted PA's involvement in the kayak coaching. The key issues that were dealt with were: height of the AQUABAC and addition of padded stiffeners on the right had side to provide additional support. An asymmetrical seat cushion was constructed to add approximately 5mm to the base under PA's right buttock. The combination of additional stiffness and adjustment to the seat pad was successful.

	AQUABAC in situ with seat removed
	Inside cockpit showing jury rig foot protection and support

12.10.8.3.4. End of week review

PA enjoyed being part of the study. I had not worked with her before, and she stated that it took a few days for her to feel sufficiently comfortable to express herself openly.

She found the back support easy to put on and very comfortable, once she had learnt about it. Initial caution due to the number of adjustments required to personalise it to her were quickly overcome once she realised these adjustments could be made on dry land before entering the boat, and once set would not need adjusting each time.

As PA's skills developed, so did her confidence. This meant PA was able to paddle with less support, suggesting that the initial solution was not only addressing her functional deficits, but also her skill deficits in terms of being on water.

PA purchased an AQUABAC at the end of the course and the back was cut to length and re-sewn to allow her to participate on her own terms

This study suggested that the current AQUABAC postural support does work in novice sea kayak conditions.

12.10.8.4. AD

AD had been involved in the initial research with a reasonably well formed concept for a postural support. During the lead up to AD's involvement in the Interventure Canada-Alaska sea kayak expedition my involvement had been tidying up his concept model and making it so that it was robust enough to last the length of the extended expedition. Issues concerning pressure sores as a result of sitting on a stone during the early part of the expedition are well documented. AD's involvement in this phase of the research follows a long period of recovery in hospital. My start-point was to ensure that further injury regardless of AD's previous laisse faire approach to skincare was not repeated.

12.10.8.4.1. Informal interview

Once again, due to the longstanding relationship with AD, it did not feel appropriate to undertake interviews in a formal setting. During the first evening an informal interview was therefore chosen, by the slipway at Lochmaddy.

AD reported that this was to be his first time back in a sea kayak following the Canada to Alaska expedition. We agreed that the focus for this week's sea kayaking was to be on how to generate appropriate pressure relief.

12.10.8.4.2. *Proposed solution*

A three layer system, comprising of one layer of 9mm closed cell foam, and two layers of Akton gel. The base layer was to be the foam, to reduce the chance of bottoming out and the double akton gel layer was to reduce the impact of sheer forces. A 4oz PU Nylon pillowcase with locating tabs was constructed with all seams on the bottom side of the pillowcase. This housed the gel and foam seat pad. In terms of postural support, AD elected to use his original carbon fibre hoop with no repairs, additions or modifications.

AD agreed to a code of conduct to ensure that the viability of his skin would be maintained, as follows:

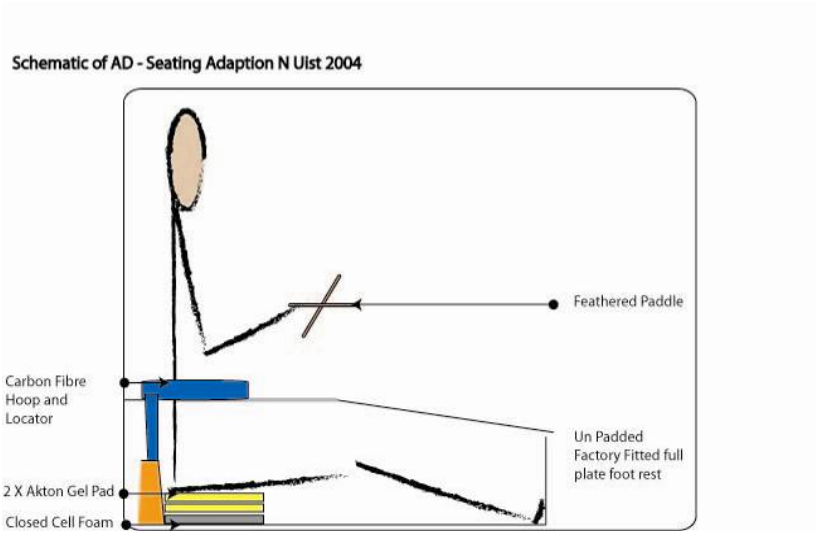
Regular checks in the morning and evening

Careful choice of clothing, especially base layer

Use of only clean clothing

To utilise a pad whilst transferring

To double check for any stones or debris that may have contaminated the seating surface



12.10.8.4.3. End of week review

AD suggested that his week had been successful. He had no marks on his buttocks, or any skin damage. AD reported that he had spent time with the sea kayak coaches looking further at rescues and providing a support role to other paddlers on the course, regardless of disability. We discussed the cost of the akton gel being approximately £150 for two sheets, which we both felt would be prohibitive for some users.

Note: During the initial interviews with AD in Aberdeen he had suggested that one of his overall aspirations was to be a sea kayak coach. During the social gathering at the end of the course, a group which consisted of all of the coaches, myself and AD in a relaxed and informal twilight setting, discussed and encouraged AD to pursue his dream of becoming a sea kayak coach. Whilst he had clearly had a very positive week, AD suggested that he would never be a sea kayak coach as he could not forsee a time when he would be sufficiently competent in rescues or rolling and would therefore never get to the mark. All of the coaches and myself disagreed with AD's standpoint and encouraged him to contact relevant individuals so that he could pursue his dream.

Laminated padding on standard sea kayak seat

Addition of a carbon fibre hoop

Fastening for front section of hoop using ratchet system

12.10.8.5. KD

KD had been part of the research project and had successfully completed the Canada-Alaska sea kayak project without incident.

12.10.8.5.1. Informal interview

An informal interview was held with KD on the first evening, upon arrival. KD expressed that she felt happy with the winged postural support she had used during the latter part of the Canada –Alaska expedition.

Her stated aim was to choose a boat that was sufficiently stable for her to paddle solo and to develop her posture so that it was more upright, thus enabling her to paddle in a more dynamic position, with more power coming from in front of the hip.

Additional or secondary concerns were her feet, padding on the knees and controlling the knee position.

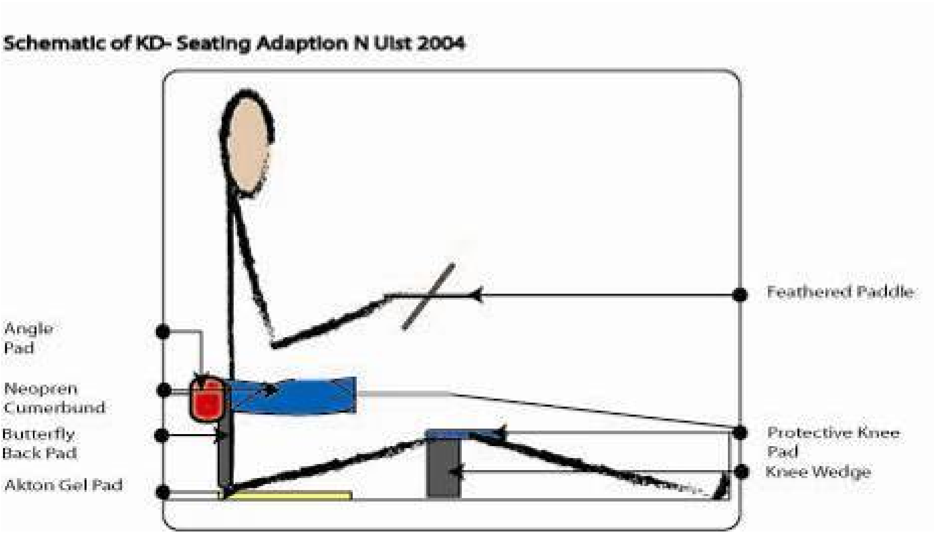
12.10.8.5.2. Proposed solution

The proposed solution did not involve the design of a postural support, but was about using the current postural support in different boats.

Brief interviews with KD were held throughout the week. They revealed that she was happy paddling with the group and developing her confidence in a single kayak.

Rescue practice revealed that the sitting angle wedge needed to be attached to the main body of the winged support.

A range of elasticated, velcro, secured, neoprene chest bands were used until the correct one was secured. This was identified with two factors, these being width and range.



Standard kayak seat

KD sat on gel pad in standard kayak seat

Butterfly back support loosely placed

Cummerbund fastened and angle pad inserted

12.10.8.5.3. End of week review

KD was ready to get on with paddling and taking on new challenges more independently. This did not come across in her post course questionnaire, but was stated to me on several occasions towards the end of the course. This influenced her answers in the post course questionnaire, as she was getting used to new boats as well as her comfort with the postural support.

The fact that she felt stable when paddling solo, and was keen to continue with this rather than returning to a double, demonstrated that the postural support was working effectively and complimenting her level of skill.

12.10.9. Post Course Questionnaire Responses

Question (1 = low score; 10 = high score)	MK	SH	AD	PA	KD
How easy was it to get into the support?	Bit fiddly, lots of different bits	10 Great for comfort & feeling of security	8 A bit of faff with spraydeck obscuring the view of what is going on	10 Once it's fitted – quite a few days faffing around, then it was really easy to bung on & go.	7 Fitting time a bit of an issue; otherwise OK
How easy was it to get into the kayak, with the support on?	N/a Not applicable as the support was fitted after I got into the kayak	10 See above	3 I get into the kayak and then put the support on which improves this to an 8	10 Fit support into boat & then get into boat.	10 Fine
How comfortable was the support that	6-7 Generally good, a few minor modifications and a	10 Very supportive	8 On longer paddles (all day – 9+ hours) some back ache	9 Very comfortable. Took a few days to get used to & then	8 I am used to this. It can rub sometimes and

Question (1 = low score; 10 = high score)	MK	SH	AD	PA	KD
you used?	bit of tweeking should be great		becomes an issue	seemed to click. Maybe something to do with confidence.	bunch around the belly, so feel a bit constricted
How important is the height of the support to your comfort?	3 L1-L3 support only needed for resting position not all the time	10 Adjustable height support is important for a club boat but it would be good to offer a customer designed support	10 My injury is T10 – the height is critical to provide adequate support but not too much to reduce back flexibility.	9 If below level of injury – very wobbly & not functional; I swim & am therefore not all that comfortable!!	10 Very
Did the design provide adequate support?	7? Unsure as was unable to test in more radical manoeuvres, however worked well in calm to mildly lumpy seas	8 Chest support would also be good but I understand the need to exit the boat quickly	9 Very infrequently I need a hand on cockpit to sit up after a roll.	10 Yes - initially needed more support & as skills/confidence/knowledge has grown, able to change type	9 Yes, with the additional foam wedge

Question (1 = low score; 10 = high score)	MK	SH	AD	PA	KD
				of support from lazyboy seat to backrest	
Is this design better than your previous postural support?	8 Did not have one	10	9 It makes me part of the boat – my leans are transmitted directly to the kayak.	10 Allows much more movement & trunk rotation & therefore control/skill progression. Can be put into variety of boats & don't necessarily need to destroy a master in order to get onto the water.	8 Yes, but I feel like this is now a bit slack
Was the design easy to adjust off the	9 Fine	10 I did not need to adjust the support	3 It is not really adjustable to any	9 Once set up – very	7 A bit of a faff as I have to get it under

Question (1 = low score; 10 = high score)	MK	SH	AD	PA	KD
water?		once it was fitted	large degree and it has been made to measure.	little need to adjust	my cag
Did the design require adjustment on the water?	Yes Occasionally	No	No	Only to tweek or when worked itself out of place.	Not at the time
If so, how easy was this?	Goal with accessible spray deck however an inversion would result in a lot of debris	N/a		10 Especially with "flasker spray-deck"	OK with help
Were you able to paddle forward effectively?	8 Yes	10	9 Trunk rotation is slightly limited compared to an A.B.	5 Taken a bit longer to get to that point – important to have	7 Yes

Question (1 = low score; 10 = high score)	MK	SH	AD	PA	KD
			paddler	easy ‘chunks’ & then ready to commit to longer trip. Vital to have trust in coaches on trip & so able to extend personal comfort zone with the knowledge that the expertise was at hand.	
Were you able to paddle backward effectively?	8-9	10	9	5 Growing in confidence & ability.	0
Were you able to	7-8	10	8	5	0

Question (1 = low score; 10 = high score)	MK	SH	AD	PA	KD
change the course of the boat independently?	Lower score due to lack of paddling skills		Lean is good – tilt is more difficult.	Again – skill development	
How stable did you fell in your kayak?	7-8	8	7 Stable when moving. Unstable when sitting still/adjusting sunglasses/taking photos etc.	5 Very wobbly to begin with & as the week has progressed – feel much safer & more skilled.	8 New kayak
How confident did you feel using your support?	7-8	8	7 See above – confident paddling. Sitting still is difficult.	8 Question of learning to trust… working it out	8

Question (1 = low score; 10 = high score)	MK	SH	AD	PA	KD
How easy was it to wash and clean the support?	Not sure yet	N/a I did not do this	9	10 Very easy – takes a while to dry though..	6-7
How easy was it to dry and store the support?	See above	I did not do this	7 Takes a while to dry.	Now I've just read this question! See above Storage fine – fits great into a laundry bag.	9
How easy was it for you to transport the support?	8-9	7 Generally I found the support really good and it made me feel supported and safe in the water. However	8	5 Bit bulky – especially to fly with but wet kayak stuff all fits into laundry bag. Starts	9-10

Question (1 = low score; 10 = high score)	MK	SH	AD	PA	KD
		to use this support you have to remove the kayak's current seating which makes it difficult to use the support in any boat. A more basic design which attaches to the boat's existing seating would be easier to take away on holiday & give me greater freedom.		to get complicated when skiing, diving etc on same trip!	
How safe did you feel with regard to getting out of the boat in the event of a	7-8 Still unsure as I didn't capsize, more tests needed	9	7/8 I feel comfortable exiting the boat. I scrape my knees/ankles but this is not due to the	9 Very comfortable in the water. Takes a bit of time to catheterise & sort out again	8 Exit fine with dry suit

Question (1 = low score; 10 = high score)	MK	SH	AD	PA	KD
capsize?			support. Pressure marks on my hips are visible but the padding on the seat seems to work.	afterwards. Need to be safe & aground in order to “do the business”.	
How easy was it to take part in a rescue using your support?	Not sure yet. Further tests needed.	9	6/8 As a rescuer: 8 – as a rescuer it is good As a victim: 6 – as a victim it needs care to replace the support in the socket after a ?	10 As a rescuer: Only managed in postural support. Able to empty boat & help victim back in. As a victim: Fine – takes a while to rejig. Easier with back support.	8

Question (1 = low score; 10 = high score)	MK	SH	AD	PA	KD
Is there anything else that you would like to say about the support that you used?	Lots of bits would cause mess on capsize.	I did not do this	A hinge on one side is good & reduce flex on the other side.	Thank you for introducing me to action!	Would like to be a bit stiffer
Is there anything else that you would like to say about your ideal support?	Simple strong quick release and in some way integral to the boat so if it goes tits up it's easy to rectify. Thank you. Mike.	Please see my comments on the previous page.		Yes – thanks Suresh!	Want to explore cushions

12.10.10. Summary of Results

12.10.10.1. Questionnaires

It took a bit of time to get into the support they were using, but once the fittings had been adjusted they did not require much further alteration once on the water. While some had their support fitted in the kayak and then got into it, others had a design which required them to put it on once in the kayak. Those with a higher level of injury than L1 found the adjustable height was important to meet their requirements. All found the support they utilised comfortable and effective in providing support for a variety of strokes.

Not all the participants participated in a capsize drill. Those that did found it more effective when using their postural support, especially when taking on the role of rescuer. When in the role of victim they noted it took a moment to rejig the fittings.

Not all the participants had the opportunity to wash and dry the support they had used, but those that did found it easy to clean if rather slow to dry.

Their main concerns were the bulkiness of the design especially if travelling and the number of parts that could have to be gathered after a capsize.

Those who had used a different support previously felt the design they utilised during this study was an improved solution.

12.10.10.2. End of week reviews

My work with MK illustrated that it is useful to fit a postural support prior to getting in. Need to reduce debris on a capsize and have a design that doesn't get in the way of a sometimes difficult transfer.

SH, utilizing the AQUABAC, suggested that in addition to the fitted under thigh pad, a chest band may have been useful to assist with generating a more dynamic upright stroke.

PA found that fitting and getting used to a postural support was challenging and highlighted the need to get used to a new piece of equipment or develop confidence before being able to give meaningful feedback.

It was reassuring to work with AD once again and to develop a solution for the seat pad which allowed AD to paddle without skin damage. AD also identified his aspirations to become a sea kayak coach, which on discussion with the coaches during the course, was felt to be within the realms of a normal intermediate sea kayak experience.

Working with KD, the focus was on sitting angle and utilizing a single sea kayak.

12.10.11. Reflection

12.10.11.1. Experience

The study took place over six days on the island of N Uist. It was supported two community based organisations (John Muir Trust and Interventurre), with additional support provided by Equal Adventure. The research was placed within a course framework that presented sea kayaking as a way of engaging with a wild place and gaining independence. Both disabled and non-disabled people participated in the sea kayaking. They formed a communal group which was able to provide the day-to-day support required for the disabled participants to sea kayak as part of the main group whilst at the same time be involved in the generation of a range of three designs of postural support. Novice participants with SCI benefited from previous work in the area, utilising the AQUABAC with minor modifications.

12.10.11.2. Express

I feel that this was the most successful piece of user-centred design research to date, and feel that it gave the participants a positive experience in exchange for their involvement in the research. Outside of the research arena the project has been held up as a model of good practice and used by the Scottish Canoe Association as part of its equality standard bid. In addition, talks and presentations based on this study have been used within coach education in paddlesport in the UK. All in all I feel that finally the research is gathering pace and maturity, and delivering results for community, participant and designer.

12.10.11.3. Explain

The study took place with the support of a range of coaches and helpers who provided the educational and pastoral support to help make the logistics for the course run smoothly. It was because of the quality of the coaching that I was able to focus solely on the development of the equipment.

Having a range of disabled kayakers participating in a community recreational setting using an educational framework provided an ideal hothouse for the development of equipment and the codification of adaptive coaching and outdoor planning tools.

The coaches utilised a range of standard off the shelf items to adapt the environment. This included doormats, which were used to slide boats in and out of the water. Slings were used to facilitate indirect lifts or assistance to help maintain the body posture of coaches or volunteers whist sliding boats or providing assistance for transfers. Tarps were used to help disabled paddlers lay out their equipment or were used in conjunction with a Thermarest to create a mobile changing surface.

Paddling techniques were adapted to allow for lack of trunk control, lean or edge. The use of the head was encouraged as a counter balance to power created by the paddle. Whilst front of kayak biased strokes were encouraged, it was recognized that shorter strokes with a higher cadence may be required for paddlers with a recumbent sitting angle.

It was acknowledged that control of the feet assisted with the trim of the kayak and allowed kayakers to paddle with a reduced pulsing bow wave alternating in opposition to the kayak stroke, adding to the efficiency of forward paddling.

12.10.11.4. Explore

I would like to use this format of study again and look at ways of making it possible to engage with a wider number of participants in the same or a similar format.

12.10.12. Conclusion

Study 8 provided a re-evaluation of three postural support solutions for spinally injured sea kayakers within a coached intermediate environment. Following initial interviews and observations of the participants, questionnaires and observations were utilised to individually tailor the seating solutions. Reflection was then used to further inform the research.

This was a successful trial which allowed the evaluation of a number of components; footplate, heel pad, knee brace or wedge, seat pad. It also allowed for a number of support options; Butterfly, Hoop, Dynamic. This study was based on community participation and without the extra challenges created by an expedition (as in previous research), succeeded in revealing much more about the equipment.

Once the sea kayaker had gained some confidence with the sea kayaking itself, the equipment proved itself to be efficient in providing postural support. The AQUABAC was a success for the novice sea kayakers, which means that it is possible to focus the design efforts on the development of an intermediate level support, rather than creating a design which bridges both participation modes. (Sea kayaking is often seen as an intermediate level sport within kayaking.)

The intermediate kayakers revealed an improvement in their performance. Their design interventions identified components which, when combined, may well create a modular system that would be capable of supporting the needs of a wide range of intermediate sea kayakers with spinal cord injury and complimentary balance needs.

The study revealed that the design solutions which each of the participants utilised have merits. None of the participant feedback was dramatically negative. This suggests that the design solutions could be used as a menu of design modules or features for a synthesised modular design. Getting in and out, adjustment and complexity during a capsize remain factors which are of high importance to the participants. Consideration should be given to the nature of the fitting. The question remains as to whether the support locates into the boat prior to the participant getting in or is added once the participant is in the kayak.

The reflection revealed that it is possible to create meaningful intermediate sea kayaking opportunities without injury to staff or participants through the use of:

- good choice of location
- planned coaching sessions
- understanding of the environment
- minor adaptations or additions to standard sea kayaking equipment

Being able to focus solely on one element of the development cycle proved to be highly successful. This involved both financial and logistical input from a number of organizations, which I recognise is not always possible. It is therefore important in the next study to consider a number of tools to facilitate the designer-coach role efficiently, whilst at the same time evaluating the emerging modular seating system.

12.10.13. Images

Image	**Caption**
	Utilising natural slipway and doormats to facilitate safe moving and handling, and access/egress

Image	Caption
	Independent preparation on flat, even surface
	Entering kayak on flat, even surface

Image	**Caption**
	The team
	Participation

12.11.Study 9 - Design

12.11.1. Introduction

This study was concerned with the design of practical solutions for the participants in the research to improve their performance in Sea Kayak. The study is presented as a self-contained study. As suggested in Chapter 6, the approach for this study is interpretivist. I see that my input as a designer/researcher is crucial. As a result I have separated this study from those concerned with the observation or collection of data from athletes or other stake-holders.

12.11.2. Aim

To utilize a creative design process that builds on research and learning from field-based and desk-based studies to create a biomechanically safe, highly portable, modular device which facilitates safe and efficient sea kayak performance for intermediate sea kayers with paraplegia resulting from SCI.

12.11.3. The Key Components of the Active Back Support

The literature review revealed the need to maintain a constant interface with the kayak (Section 3.1) and that the action of kayaking required the resolution of five power circles (Section 3.1.2). Chapter 3 revealed the need for the creation of a spray deck to ensure that a kayak cockpit is not swamped during use at sea in intermediate conditions, (Section 3.5).

The proposed components presented in Figure 54 are presented from the base up. This is to ensure that the device is able to create a firm base of support for the athlete, utilising the methodology revealed in study Section 12.5.3.3.9

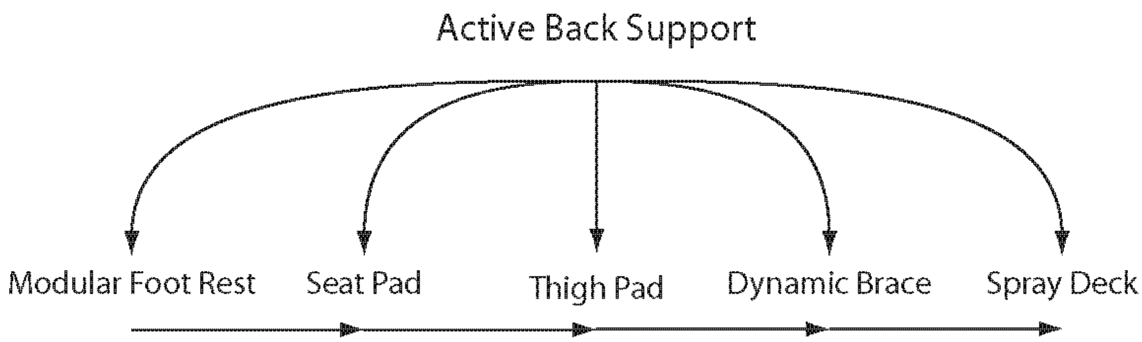


Figure 54 Components for the Proposed Active Back Support

12.11.4. Design Brief

The overall brief is to create a bio-mechanically safe, highly portable, modular device which facilitates safe and efficient sea kayak performance for individuals with paraplegia resulting from SCI.

12.11.5. Specification

This section is derived from Chapter Four of this study, Synthesis, and the findings from Field Studies 1-8. It can be considered as the driver to the design phase of this research. Elements which are drawn from the desk research are cross-referenced with the relevant section in the literature review. Elements which are derived from the field studies are referenced to the particular study. Although much of the desk-based research is taken from Chapter Four of this study, Synthesis, the emphasis is more functional rather than inquisitive. The aim is to create a metric and checklist to aid problem solving, not to create a map for further questioning.

12.11.5.1. Functional Requirements

The design must be able to be self-applied and/or self-managed for truly inclusive design, athlete independence and athlete acceptance (section 2.8).

The perception of faff must be reduced, the design must feel simple and intuitive (Section **Error! Reference source not found.**)

12.11.5.2. Performance of the Athlete

Support the body, boat, blade background and brain model of performance (Section 3.1).

allow the user to utilise a range of self and assisted rescues and recovery in deep water (Section 3.5.1)

promote the range of motion, efficiency and comfort of the performer (Section 3.6.3).

12.11.5.3. Equipment Performance Criteria

It should have a range of performance criteria to promote the ability of the kayaker to:

- take responsibility for safety (Sections 3.5, 3.5.2 and 3.5.3)
- perform (Sections 3.5, 3.5.3, 3.1.1, 3.1.2, 3.1.3, 3.4.2, 3.4.7)
- be independent (Sections 3.4.7, 3.5.3)
- takes into account the physical requirements of athletes with spinal cord injury (Section 3.2.1)
- is adaptable to different kayaks and environments (Sections 3.4.8, 3.5)
- is capable of withstanding 150 days of use (Section 3.3.1)

12.11.5.4. Seating and Posture

It is essential that the research promotes acceptance of the equipment by the disabled athlete (Section 3.2.2).

The equipment developed should enable a seating position with consideration for prescribed angles of flexion at the hips, lower back, knees and feet (Section 3.1), reduction of sheer under bony prominences, manage temperature, manage moisture (Sections 3.2.2 and 3.4.4), and provide a stable base for shoulder and arm movements to facilitate the generation of new or adapted techniques (Section 3.4.5). These factors should all be considered with particular regard to participation by athletes with the typical functional characteristics of paraplegics (Section 3.2.3).

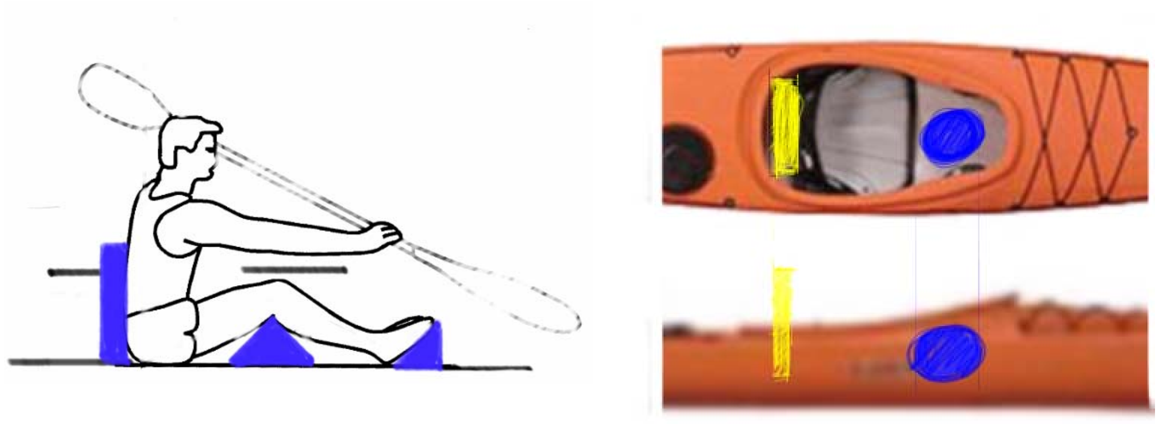
The equipment should also promote core stability, dynamic sitting, stability in the kayak and reduce musculo-skeletal stress on the body (Sections 3.2.4, 3.2.8, 3.2.7, 0, 3.2.12

The equipment should balance intrinsic and extrinsic forces that influence postural control (Section 3.3.3), thus completing the Power Circles and generating/maximising core stability (Section 3.2.5).

The equipment should be able to be used in a variety of craft in club or independent scenarios (Section 3.4.1).

Finally, the equipment should be able to be manufactured by UK manufacturers in low batch volumes (Section 3.4.1).

12.11.6. Concept Sketches



Key areas of the users body requiring support.

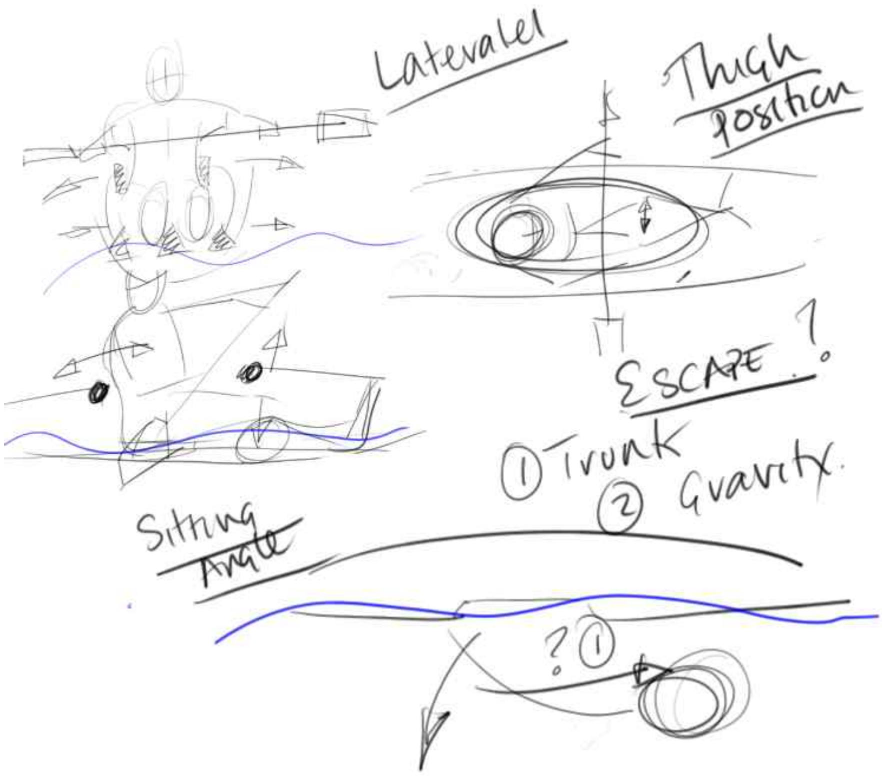


Figure 55 Preliminary Sketches

12.11.7. Detailed Design

Each component is now considered and a brief, specification, concept sketches, technical drawing, concept model and design description are presented for each module. The brief provides a statement which encapsulates the problem; the specification provides a list of performance criteria for each module; the concept sketches reveal the interpretation of the brief and specification to create the start point for the realisation of the data gathered in both desk and field studies into a new object; the technical drawings provide a snapshot of the final design that the concept model is manufactured to and provide dimensional information gathered from parametric models of each object. The models are presented as a 'one off' ready for production design and further evaluation. The design description outlines the rationale behind the final design model.

12.11.8. Modular Footrest

12.11.8.1. Brief

The footrest must create a firm base of support for the athlete's feet and maintain the position of their feet during the activity of sea kayaking. It must fit a range of craft and be adjustable to users with a range of leg lengths. The facility for easy on-land adjustment during a day trip and the potential to add padding is also required.

12.11.8.2. Specification

In addition to satisfying the overall specification the footrest must be:

- Portable
- Fit into a number of craft
- Locate onto a badger or bar foot rest to create a full plate foot rest

- Cater for individuals with a range of leg lengths
- Adjustable to the shapes of a hull of the kayak without damage to the hull.

12.11.8.3. Concept Sketches

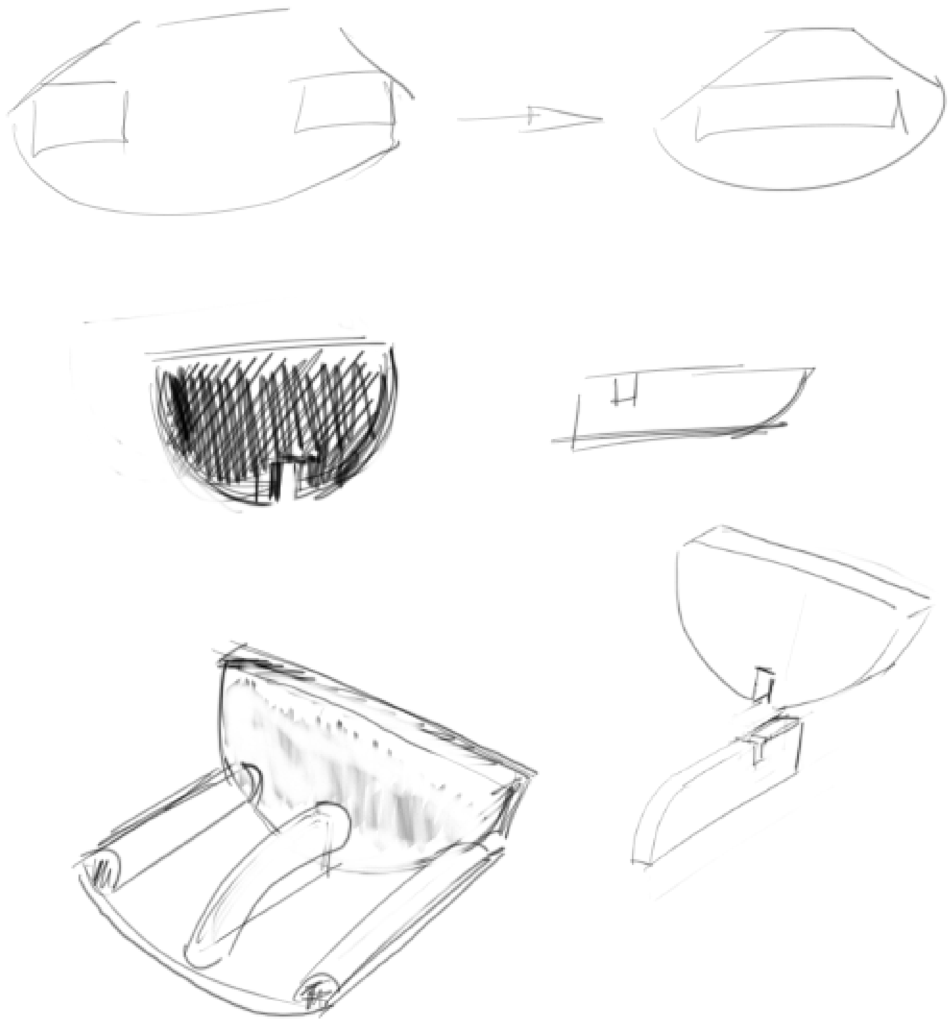
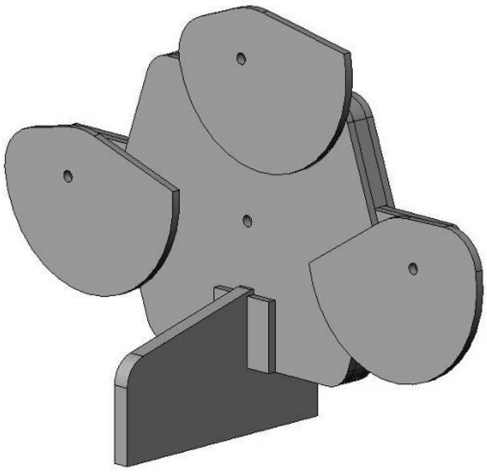


Figure 56 Concept Sketches - Modular Footrest

12.11.8.4. Technical Drawings



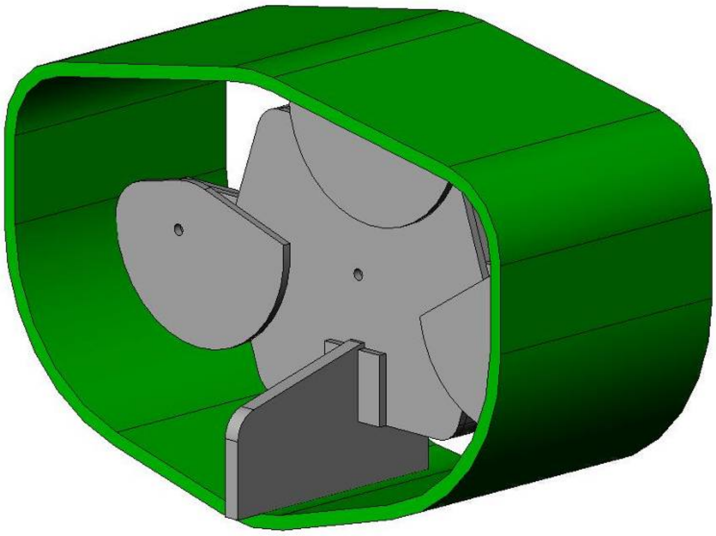


Figure 57 Technical Drawings - Modular Footrest

12.11.8.5. Model Images

Figure 58 Model Images - Modular Foot Rest

12.11.8.6. Design Description

The solution provides a full plate footrest solution which can be placed into any sea kayak regardless of the dimensions or design. The base which acts perpendicular to the main plate provides stability and is triangulated by the foot rest's interaction with the sides of the kayak. The footrest may be located using cable ties. The cams at the end of each arm can be rotated to configure to the curves of a sea kayak.

A central tightening nut constrains the three ply construction, rendering the arms immoveable for use.

The design can be provided as a self make or as a batch produced CNC routered object from either natural polypropylene or plywood, depending on batch sizes and manufacturer availability.

The design is highly portable and flat pack, allowing intermediate participants to develop their personal skills by utilising different boats in a range of environments.

This component can be manufactured from polypropylene sheet using a band saw drill. Alternative materials can be sheet ply finished with cellulose.

Sheet templates can be utilised for low volume batch production.

For higher level batch production a vacuum bed CNC routing by sheet material supplier can be utilised.

12.11.9. Seat Pad

12.11.9.1. Brief

This component must spread load across the user's seat surface to reduce pressure concentrations. The design must not raise the centre of gravity of the user and must provide a low cost highly portable solution.

It is recognised that there is a trade-off here, as it may not be possible to achieve fixation of the SIJ because the very base of support may be outside the control of the user when they utilise the device.

12.11.9.2. Specification

In addition to complying to the overall specifications the seat pad must:

- Not increase the seated height of the performer
- Highly robust
- Able to be located onto a range of sea kayak seats and therefore be highly compliant.

12.11.9.3. Concept Sketches

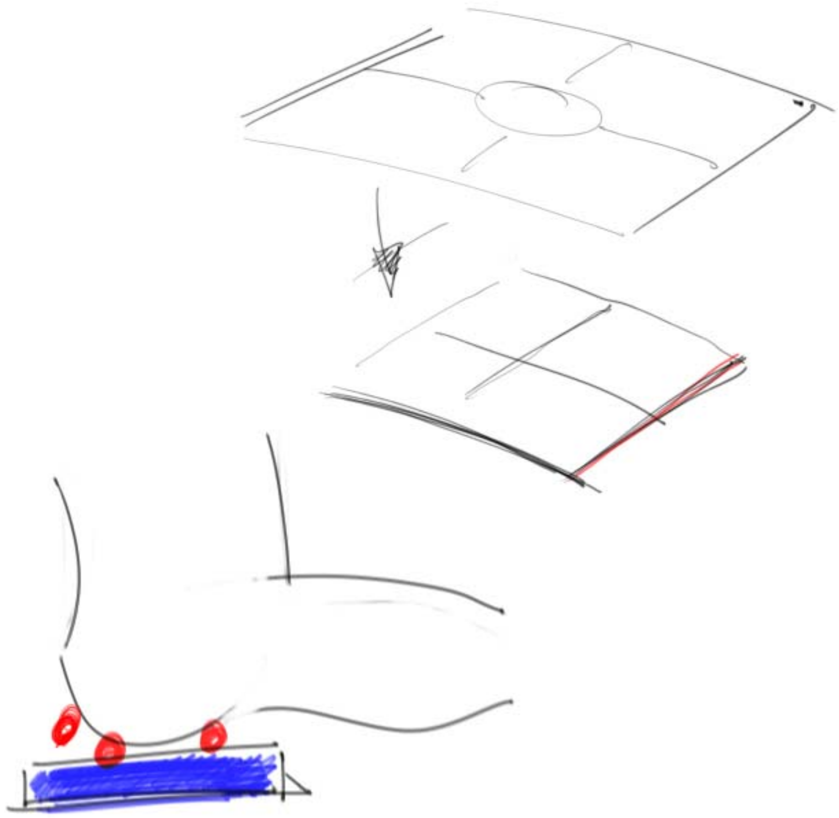


Figure 59 Concept Sketches - Seat Pad

12.11.9.4. Technical Drawings

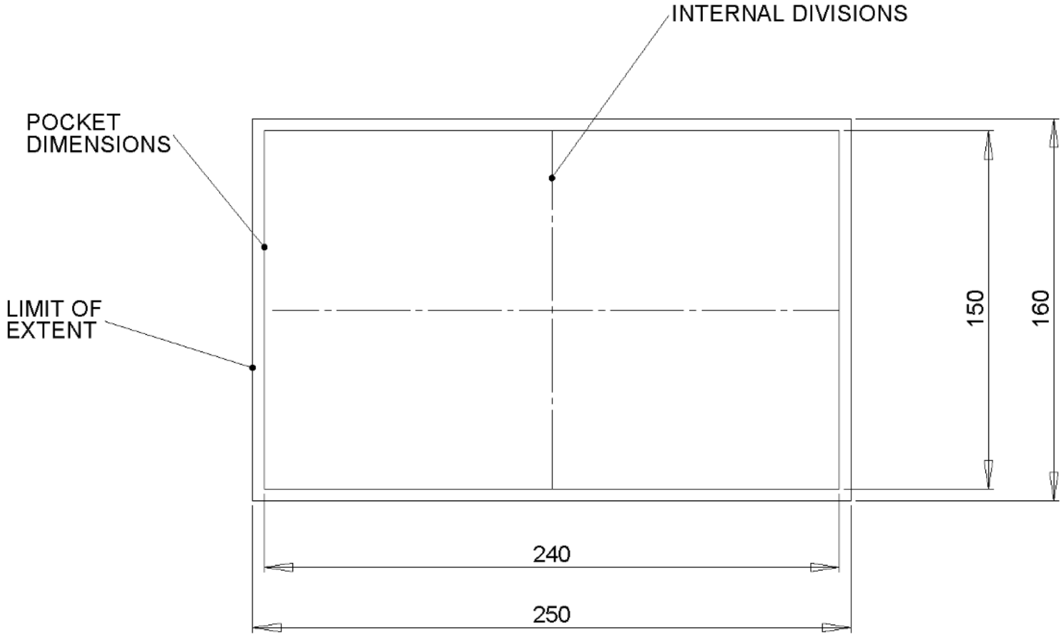


Figure 60 Technical Drawings Seat Pad

12.11.9.5. Model Images

Figure 61 Model Images - Seat Pad

12.11.9.6. Design Description

Gel – pocketed to increase the ability of the concept to conform.
Cover bony prominences.

Dimensions based on distances between ischial tuberosities.

12.11.9.7. Production Notes

An initial run has been created using a specifically designed mould. Further testing and certification is required to persuade the manufacturer to venture further into manufacture. As such this is beyond the scope of this study.

12.11.10. Thigh Pad

12.11.10.1. Brief

This component must provide support to the knee joint to facilitate a splayed leg posture during kayaking. The device must be highly adjustable and allow for the safe and easy access and egress from the craft by the user in both standard conditions and also during a rescue.

12.11.10.2. Specification

In addition to meeting the overall design specification the thigh pad must also:

- Hold the users placid lower limbs so that the knees maintain contact with the knee braces of sea kayaks
- Not impede the exit of the kayaker from the cockpit during an emergency exit
- Not damage the skin
- Allow for a range of leg sizes and dimensions

- Have a quick release that is able to be used in a similar way to a spray deck in order to utilise good kayaking techniques.

12.11.10.3. Concept Sketches

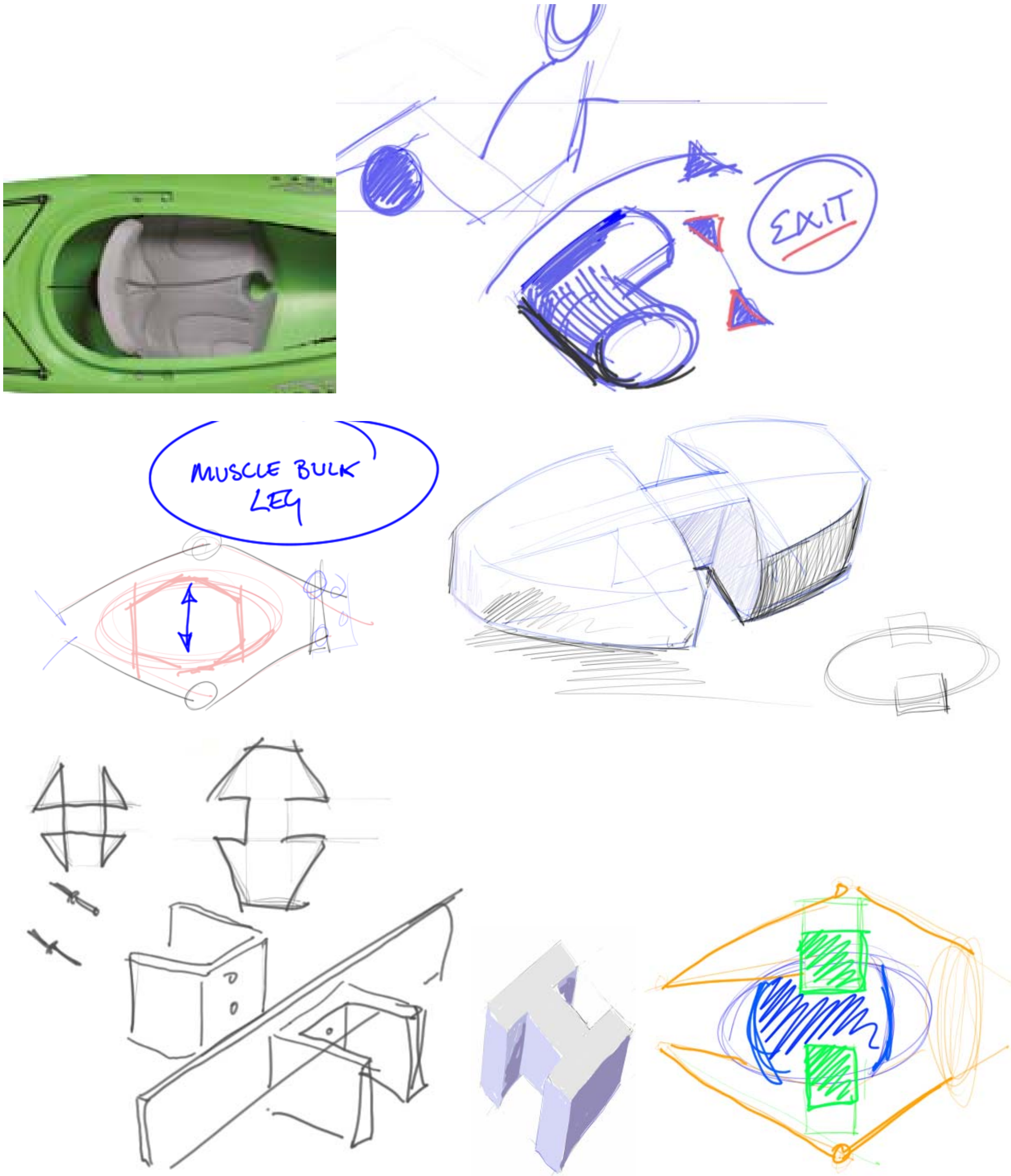


Figure 62 Concept Sketches - Thigh Pad

12.11.10.4. Technical Drawings

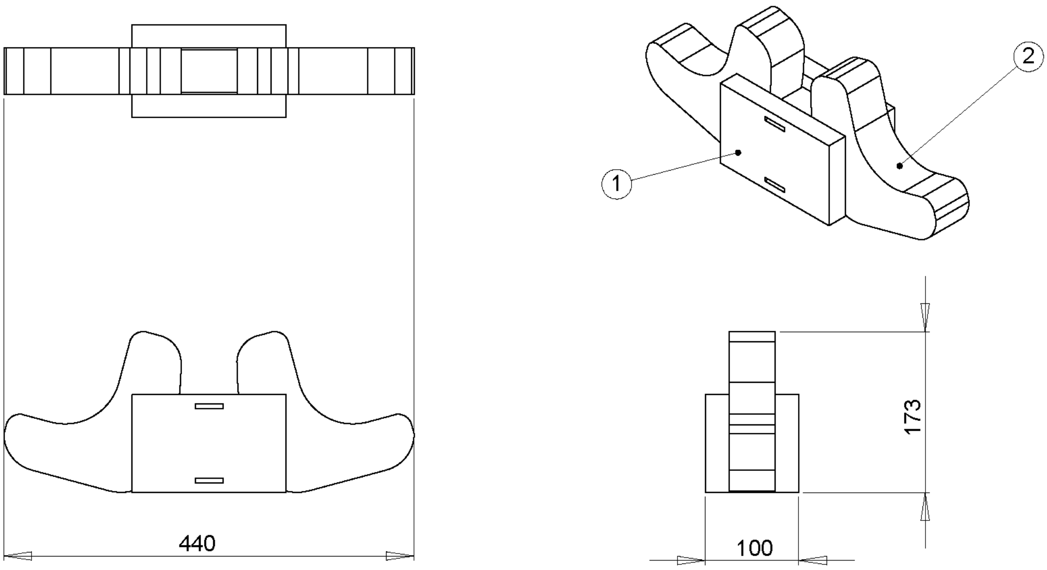


Figure 63 Technical Drawings - Thigh Pad

12.11.10.5. Model Images

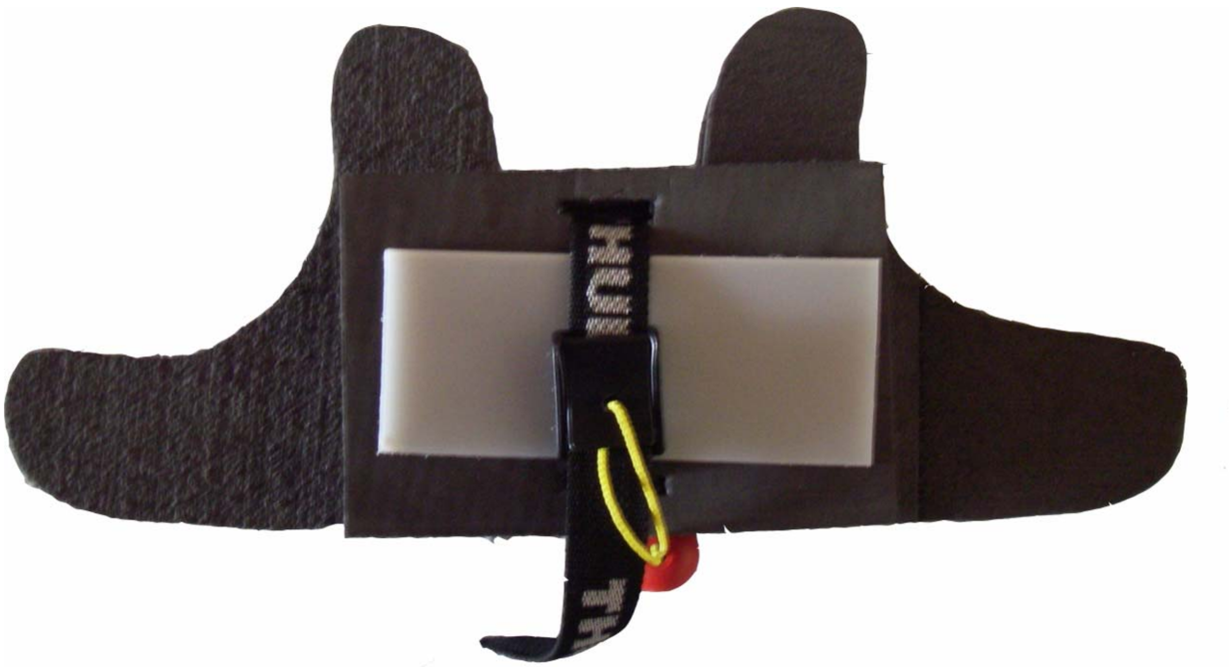


Figure 64 Model Images - Thigh Pad

12.11.10.6. Design Description

Constructed from layered, closed cell foam for comfort and flotation, nylon and plastic strap arrangement for drawing assembly together. The design allows for low cost batch production and can be laminated or created from a single thickness of foam depending on batch size and material availability.

12.11.11. Dynamic Brace and Base

12.11.11.1. Brief

This is the core component of the device and must provide support for the back by working in sympathy with the body's structures, to allow the user to manufacture core stability.

The generation of elements that can best replicate intra-abdominal pressure to manufacture form closure and the provision of a range of stiffeners to mimic the action of the erector spinae is also required.

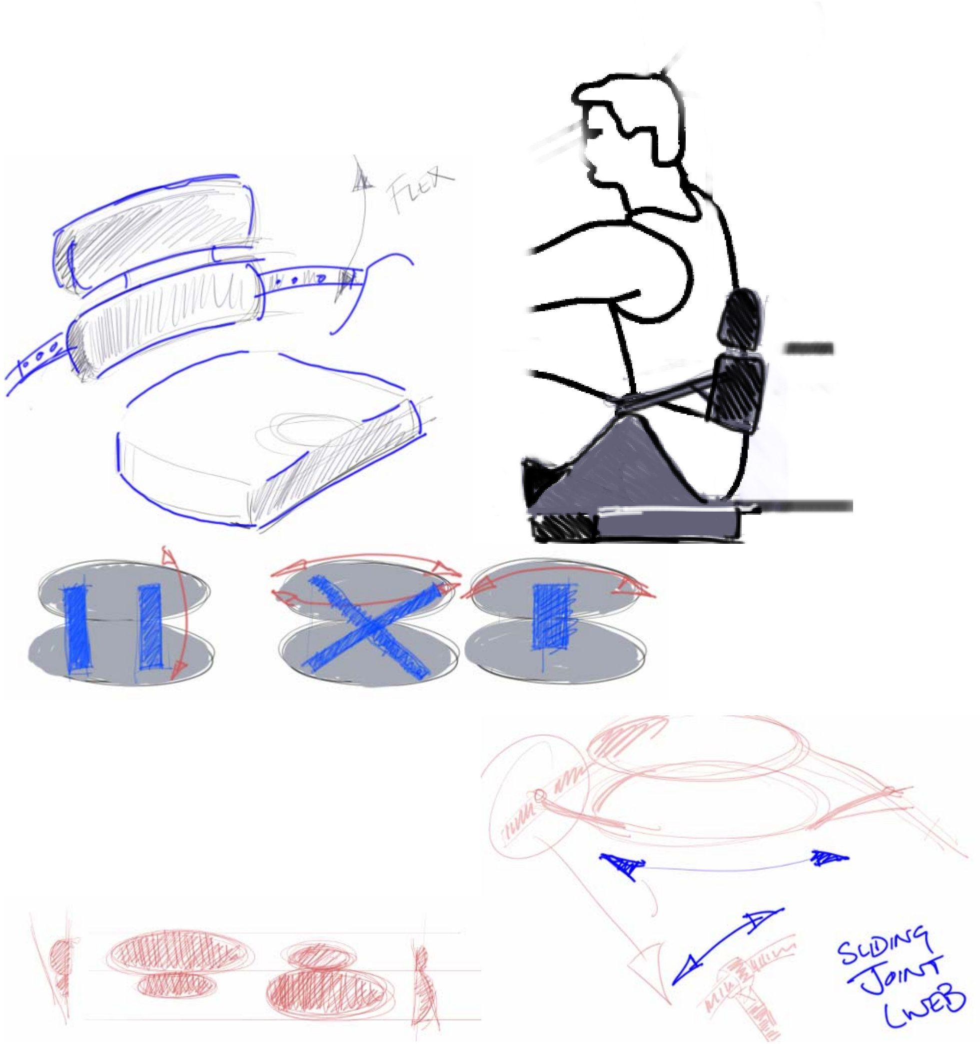
12.11.11.2. Specification Dynamic Brace and Base

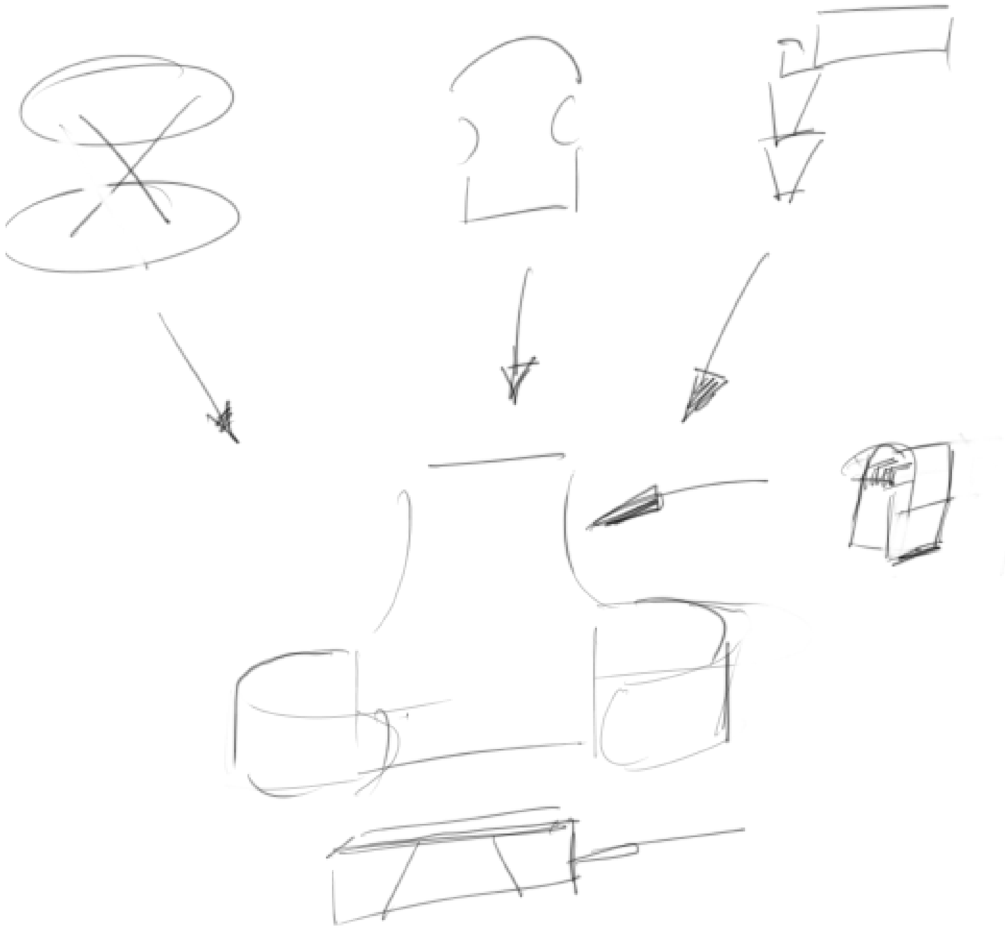
In addition to satisfying the overall design specifications the dynamic brace and its base must:

- Assist with the creation of sitting balance for the user
- Able to be used with standard sea kayak clothing
- Able to be used with standard sea kayak spray deck
- Able to be used with a range of craft
- Not require any permanent adjustment or modification to the sea kayak

- The combination of the dynamic brace and its base attachment should provide a firm yet dynamic compliment to any available core function.

12.11.11.3. Concept Sketches Dynamic Brace





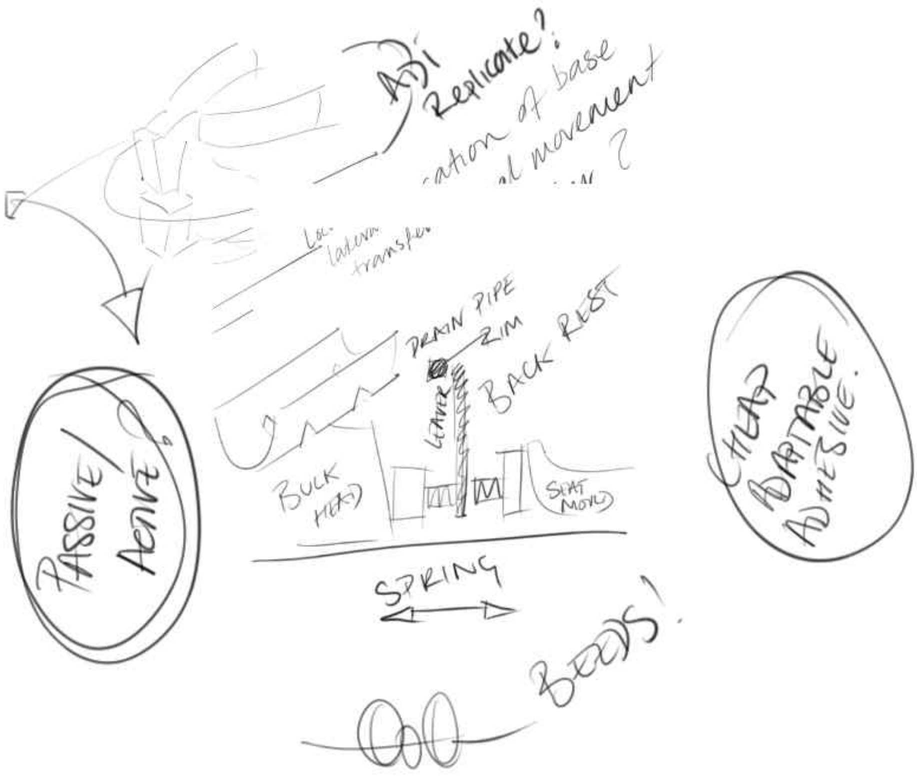
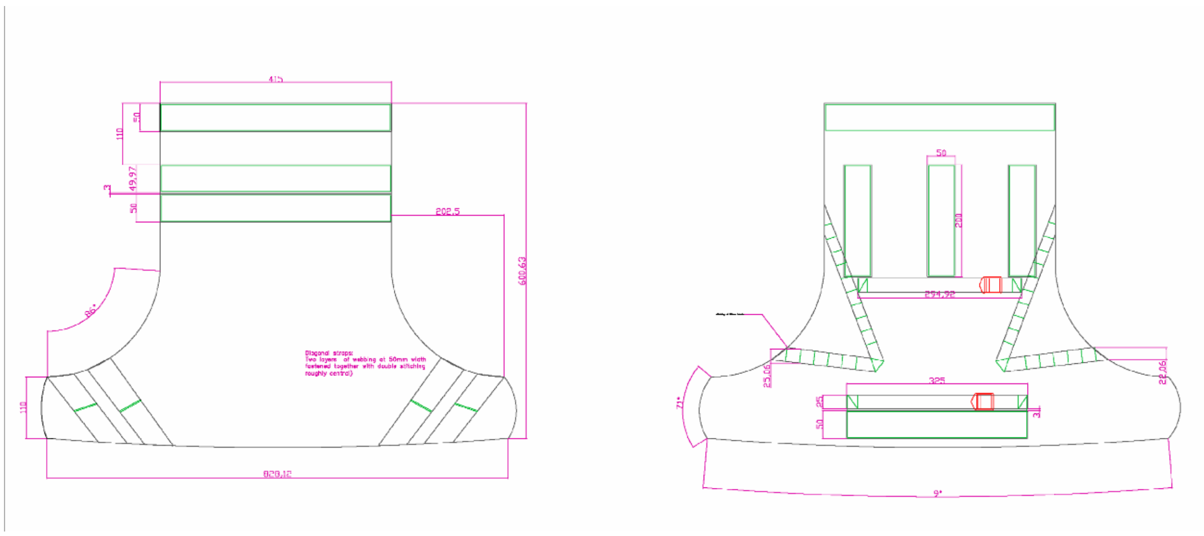
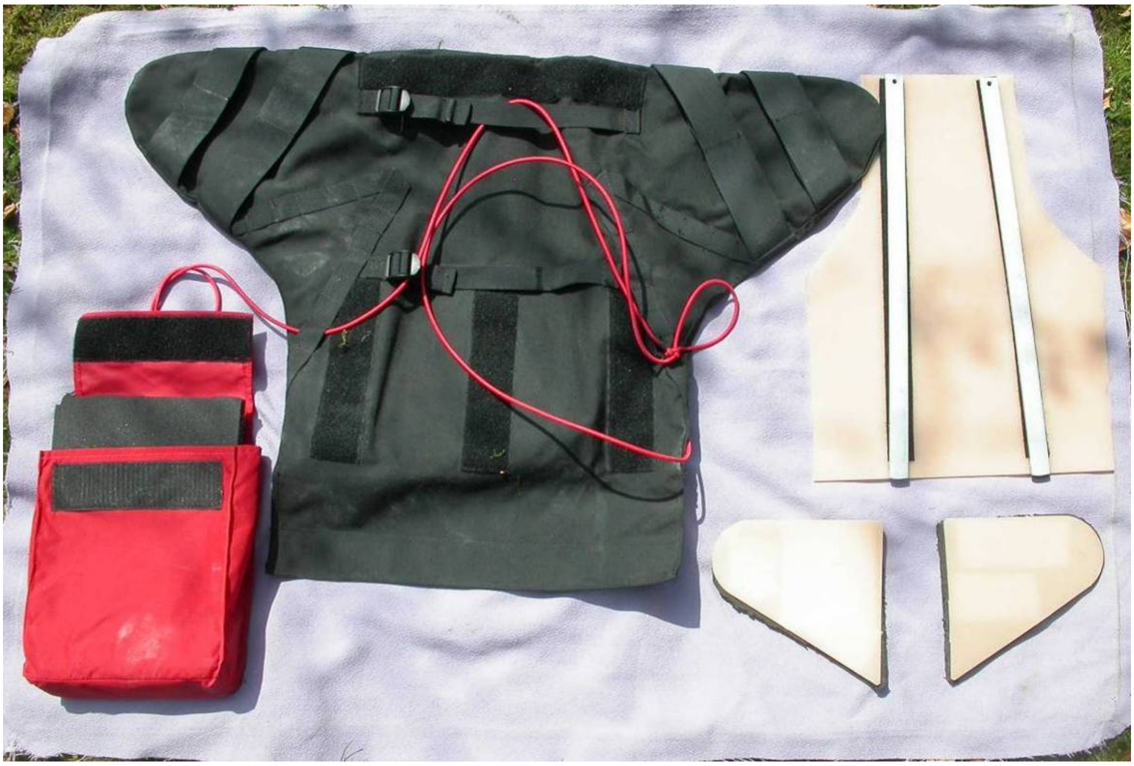


Figure 65 Concept Sketches - Dynamic Brace

12.11.11.4. Technical Drawings





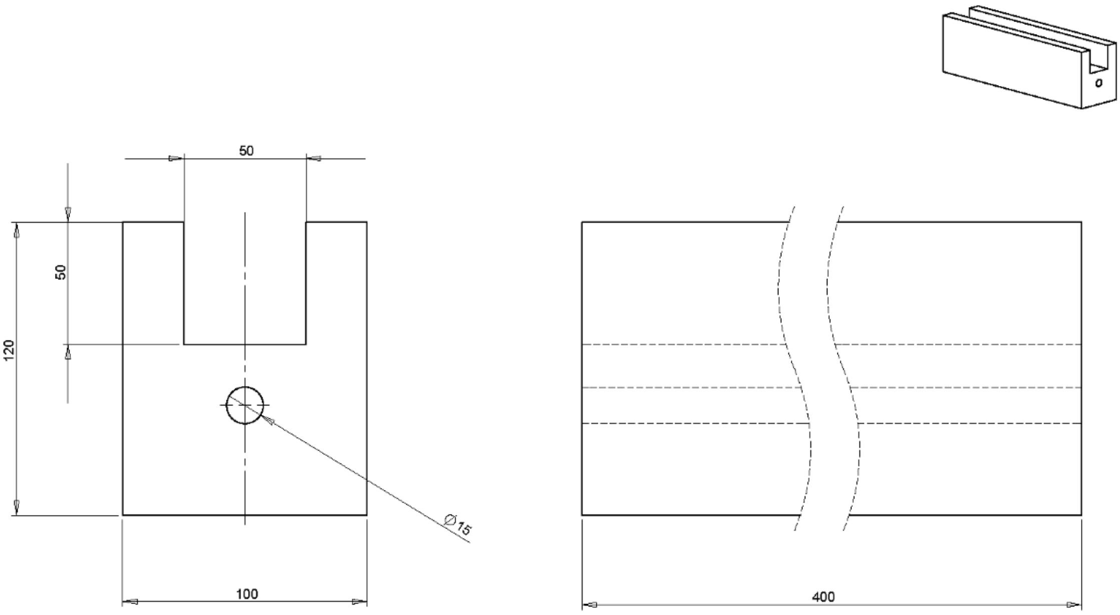


Figure 66 Technical Drawings - Dynamic Brace and Base Channel

12.11.11.5. Model Images

12.11.11.6. Design Description

The dynamic back support is a pillow case construction that houses a modular stiffener, and padding arrangement that can be adjusted by the user, utilising low tech methods. Aluminium bar and natural polypropylene are used as stiffening components. Closed cell foam is used for the padding. The angle adjustment is provided by the red pouch which contains a number of layers of closed cell foam that can be used to create a change in the sitting angle of the user.

The fabric is 5oz PU nylon which is common to the outdoor industry and has been selected because of cost, durability and to provide a sliding surface so that the support is less likely to impede exit during a capsize.

12.11.12. Spray deck

12.11.12.1. Brief

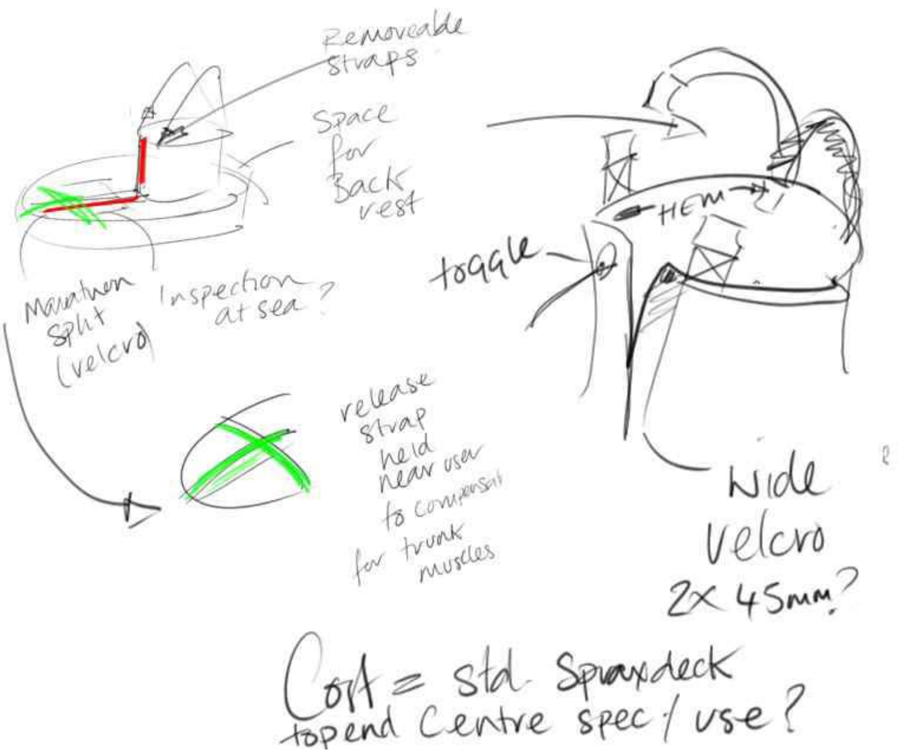
This component is required to increase the sea worthiness of a craft by sealing the cockpit and hence reducing the access of water into the main compartment of the boat. The spray deck must also provide easy on the water access to postural adjustment and not interfere with the function of the active back support.

12.11.12.2. Specification

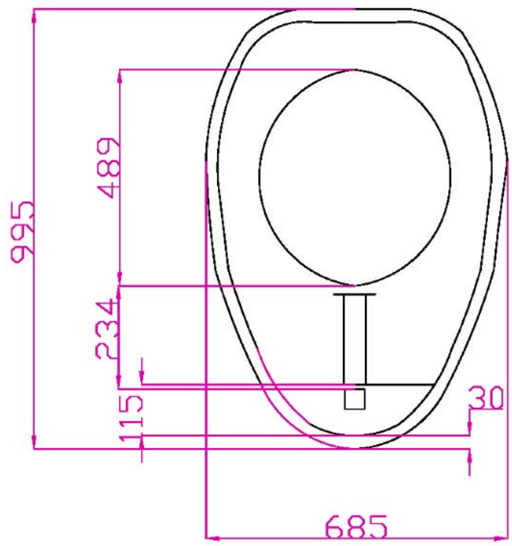
In addition to meeting the overall design specification the spray deck should:

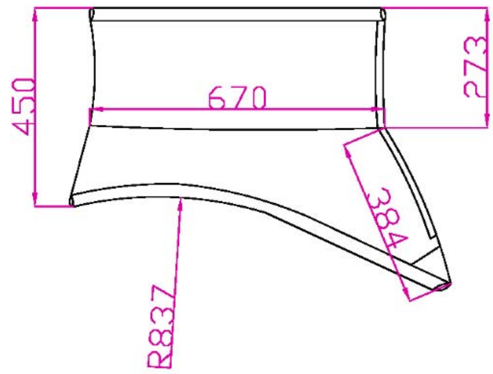
- Allow for the shape of a range of postural supports for both beginner and intermediate level performer
- Not interfere with the trunk rotation of the performer
- Allow for the inspection of the legs and lower body (to assess symmetry and padding) whilst at sea, thus improving performance and allowing the performer to check or adjust pressure during long open water crossings
- Be releasable during a capsize and exit without the need to lean forward
- Fit a range of cockpits easily with limited ranges of movement.

12.11.12.3. Concept Sketches



12.11.12.4. Technical Drawings





12.11.12.5. Model Images

12.11.12.6. Design Description

The spray deck is constructed from 8oz neoprene-coated nylon, colours were chosen with sympathy for contrast. A velcro closure goes along the middle of the deck to allow for opening at sea. The release loop is held deliberately towards the performer so that a release is possible whilst inverted. The cut of the deck is deliberately baggy to allow for a range of postural supports including the active back support.

12.11.13. Study Reflection

12.11.13.1. Experience

This study involved the generation of concepts, followed by detailed design work which involved specification of materials and sizes to components. The study drew upon my experience from both the literature review and my field research, enabling me to act perhaps more intuitively, balancing rational and creative processes. It involved the creation of a number of prototypes for test and also involved negotiation with external manufacturers and grant applications in order to fund the generation of prototypes.

12.11.13.2. Express

I felt at home during this study and enjoyed the relative freedom of creative thought and problem solving. This study was relatively solitary in nature when compared to the previous nine pieces of field research. I also found the expression of concepts satisfying in this study, as they could more readily be complimented by visual representations.

I felt that the negotiations with the manufacturers and funders were successful as they allowed the creation of four sets of prototypes.

It was also of great relief that the study was generating a tangible physical outcome which may be of benefit to the community of disabled adventurers who have supported earlier parts of this research.

12.11.13.3. Examine

This study provided the practical outcomes which many of the study participants had wanted at the very start of the research.

Throughout the process of the previous research studies there had been an underlying tension created by the wants of the participants to get on with participating in sea kayaking at an intermediate level and the needs of the researcher to find solutions. Sea kayaking for people with SCI can only be undertaken during the summer months due to the level of discomfort that winter weather creates. This means the process of equipment development was relatively slow, and certainly slower than the participants might have either expected or desired.

This study enabled me to truly look at the equipment in detail and draw upon findings from other studies, including process (Iceland), techniques (Loch Morlich and Skye), environment (Canada), as well as drawing directly on the data concerned with equipment (N Uist).

12.11.13.4. Explore

Generating a design solution which is able to be replicated at low cost will facilitate the involvement of a greater number of participants in the final stages of this research.

Perhaps now is the time to evaluate the current design from this study with a new set of participants who are truly intermediate performers, as those with whom I started are possibly now moving towards becoming advanced paddlers.

In order to conclude the research, I propose to revisit the findings concerned with research techniques and fieldwork processes, to evaluate them alongside the active back support.

12.11.14. Study Conclusion

Study 9 utilised a creative design process to build on research and learning from previous field-based and desk-based studies to create a seating device which facilitates safe and efficient sea kayak performance for intermediate sea kayers with paraplegia resulting from SCI. The study drew upon the desk-based literature review and field-based involvement to form the foundation of a simplified specification.

The study was successful and concluded with the development of a practical solution that is able to be replicated at relatively low cost in order for further testing or user-based research.

The study created a piece of equipment that is sympathetic to the human body whilst kayaking. It also created equipment that is light and easy to carry, including by a wheelchair user. It has the ability to be tailored to the needs of different participants, dependent on the level of support required.

The active back support is now at a stage where it facilitates safe and efficient sea kayak performance for intermediate level sea kayakers with SCI. The design outcome will be evaluated in Study 10.

12.12.Study 10 North Uist Outer Hebrides

12.12.1. Introduction

The following research project was undertaken as part of a multi agency outdoor pursuits programme. In total, two weeks of activity were run, week one at Kintail and week two at Lochmaddy. Week one was not part of the study and was used to allow the staff team to assemble and confirm working practices. Week two was then utilised as part of the research. A description of both weeks' activity is described by Interventure in its web report as:

'Week 1 – Kintail

Kintail & Isle of Skye

Supported by The Robertson Trust in partnership with the John Muir Award Activities Programme.

Technical support from Equal Adventure Developments.

This was the first time that a trip aimed at intermediate sea kayakers had been run. It involved a group of 13, made up of 3 experienced coaches (2 of whom also gave technical support to paddlers requiring additional equipment and postural support), 3 volunteers and 7 participants. Overall the group included 6 people with disabilities, 5 of whom were wheelchair users. Based at the Kintail Outdoor Centre, which sits nestled in the hills near the head of Loch Duich, the group had a range of beautiful places to paddle. Sea lochs gave everyone the opportunity to hone skills, practice rescues and enjoy the stunning surroundings - inlets on the eastern side of Skye offered more challenging tidal waters and some great surfing (even if most of the group got wet in the waves!) and *longer day journeys were possible. The diverse nature of the group created challenges and getting everyone on and off the water was a daily puzzle. The coaches worked hard to ensure that everyone felt safe - and stretched - while improving skills, confidence and independence on the water. Highlights of the week included paddling from Plumpton to Kyle of Lochalsh and under the towering Skye Bridge, finding some big waves on a couple of windy days and numerous floating picnics.*

Week 2 – Lochmaddy

Supported by The Robertson Trust in partnership with the John Muir Award Activities Programme.

Technical support from Equal Adventure and BIB was provided as part of a doctoral training project.

For the second year running, an enthusiastic group of kayakers met for a week of sea kayaking at North Uist Outdoor Centre in Lochmaddy. The group of nineteen had a wider range of skill levels and aspirations than last year, and the Hebrides' stunning range of both exposed and sheltered water was a perfect setting to develop everybody's skills. The group split into two for paddling trips so that we had less impact on the peaceful island environment, our awareness of which was raised by the presence of a John Muir Trust volunteer and plenty of books and information. Besides kayaking, activities included a jellyfish survey and whale spotting, though unfortunately we didn't find any! We also spent time practicing capsizes, rescues and rolling - not always deliberately planned! For people with physical disabilities who needed support fitting out their kayaks, plenty of foam and expertise was supplied by

Equal Adventure and Brunel Institute for Bioengineering as part of a doctoral training post, and experienced coaches came from Adventure Hebrides, Peak Wave Coaching and Simon Clooney. The diverse group included 3 coaches, 1 technical support, 3 volunteers and 11 participants, 5 of whom were wheelchair users.'

Interventure - Equality in outdoor activities. Available at: http://www.equaladventure.org/interventure/pastevents05.htm [Accessed December 30, 2008].

12.12.2. Logistics and Planning

The format from Study 8 was utilised, but instead of having three different seating designs, there was only one design based on the AQUABAC II. A greater number and quality of this prototype equipment was made available, based on the results gained from the previous year.

12.12.3. Additional Medical Support

All staff were made aware of appropriate procedures for the administration of intra-muscular (IM) medication for one participant, for anaphylaxis due to food and airborne irritants. Administration of oxygen for home consumption both on and off the water, along with management of airway was also considered.

12.12.4. Ethics

This was dealt with by the trustees of Interventure.

There were potential ethical issues in relation to one participant, due to her allergies to many substances and food which most of us would take for granted, including diesel, solvents, most foods apart from chocolate and pure sugar. A number of steps were taken to ensure that she was a primary risk taker. These included completion of a risk assessment three months in advance of the course, informing Interventure and John Muir Trust trustees, sourcing of local household oxygen at Kyle of Lochalsh chemist, informing Stornaway coastguard, informing and negotiating with Calmac Ferries, informing and negotiating with the bunkhouse, having a specific team briefing, gaining letters of consent from next of kin, asking that next of kin be available by telephone during her attendance on both weeks and no more than 20 miles away, having staff training and familiarization with the participant upon her arrival, negotiating a standard operating procedure for dry land and water-based activities, organizing a chain of command and emergency action plan, requesting insurance details.

12.12.5. Research Aim

To evaluate the practical and methodological product of the previous studies and research.

12.12.6. Objectives

- To evaluate the seating concepts generated as part of the previous stages of the research.
- To trial the field-based data collection tools generated during the research process.

12.12.7. Seating Design Preparation

Four sets of the following items were manufactured prior to the course:

- Modular foot rests
- Knee wedges

- Seat pad
- Back support base
- Active back support
- Cummerbunds
- Spray deck
- Field-Based Data Collection Tools
- The following documents were prepared:
- Introduction document to the research
- Functional questionnaire – about you
- Product review form
- Sea kayaking curriculum
- Anthropometrics form

12.12.8. Method

An initial interview and observation was held with each participant beside the water, to gain information about the participant's current seating arrangement. Following this, individually tailored adaptations were made to the AQUABAC II. The participant then took part in a coached session and tested their new seating arrangement. The process was repeated throughout the week, with adjustments made based on the participant's feedback, until an appropriately individually tailored seating arrangement was found.

The following methods were utilised:

- Field-based data collection tools, in the form of questionnaires, were utilised to assess the seating concepts
- Participant observation was utilised to add depth to the researcher's understanding of the validity of the seating concepts
- Reflection was used to provide an assessment of the field-based data collection tools.
- Field Based Collection Tools

Pro-formas were used to collect field evidence. They were presented as A3 folded to A4, double sided clear laminated print outs, that could be marked by a waterproof, wipe off pen or pencil i.e. a china-graph pencil. The product review forms were designed to capture information concerning the performance of the equipment, the nature of the tester, the team involved and the perceptions of the solution.

The format and structure of the product feedback tool was designed to provide a more transparent method for capturing data.

The field-based collection tools come in three sections:

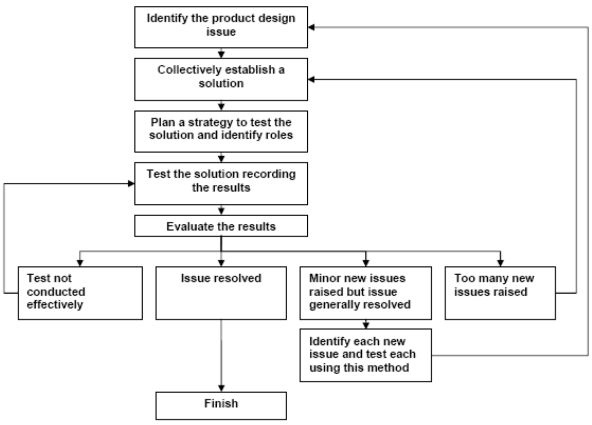
- An introduction to the field trial process
- About you
- Product review form

An introduction to the field trial process

The Product Review form is used to capture data on a specific design issue. It encourages a collective approach having identified the issue to investigate a solution, establish individual roles and test it, capture the results of the test and then evaluate these data in relation to solving the issue.

We recognise that design is a cyclic process and use this approach to methodically identify the functional needs of equipment. Once a solution has been effectively tested and evaluated in relation to the design issue it is then possible to determine if the solution resolved the issue, created additional minor issues which could be resolved, or if a new solution is required.

I



This is a front cover note that is designed to explain in simple lay terms that all of the participants are in a test environment.

About you

About You

Focus Group –

About You

1. Introduction

Thank you for your involvement in the development of EAD products. The aim of this questionnaire is to capture some of the information about you to enable us to create a profile of the complete focus group. EAD works from a functional and practical foundation. The research is being conducted as part of a PhD research project based at Brunel Institute for Bioengineering at Brunel University. Your input will help with the PhD research and then support the development of adaptive outdoor equipment into the future.

2. Just to Confirm – A summary of you

In the space below please could you outline how you positively describe yourself?

3. In a little more depth

Name:	
Age Range:	□ 16-18 □ 18-21 □ 22-24 □ 25-34 □ 35-39 □ 40-50 □ 50+

2

Designed to provide positive, functional background information about the participants.

<table>
<tr>
<td>About You

Can you read this sheet?
□ Easily, without glasses
□ Easily, with glasses
□ Difficult, even with glasses
□ No
□ Other/notes…

Can you differentiate colour contrasts?
□ Yes
□ No

Can you hear me?
□ Easily, without hearing device
□ Easily, with hearing device, which is …
□ Difficult, even with hearing device, which is…
□ No
□ Other/notes …

Can you reach over your shoulder as if to scratch your back?
□ Easily
□ Reduced range of movement
□ With assistance from other arm
□ No
□ Other/notes…

Can you transfer from this chair to the next?
□ w/c user
□ Ambulant without aids
□ Ambulant with…
□ Easily, without aid
□ Easily, with aid
□ Difficult, even with aid
□ No
□ Other/notes…

3</td>
<td>Designed to help the participants think about what they can do so that they become primary risk takers.</td>
</tr>
<tr>
<td>About You

Can you pick up this pen with your…
Left hand? □ Yes
□ No
Right hand? □ Yes
□ No

Can you move this chair?
□ Yes, with ease
□ Yes, with assistance for balance/other…
□ No, because…

Do you exercise outdoors?
□ More than once a week
□ Once per month since…
□ Less than 10 time per year
□ Not in past year

Anything else you'd like to tell us?

4</td>
<td>Designed to gather information about the functional abilities of the participant and help them to realise what they do already in functional terms.</td>
</tr>
</table>

Product review form

Product Review

Product:		**Tester:**	
Date:		**Coach:**	
Location:		**Observer:**	

Before you begin define the problem?

Define what is to be addressed, is the focus:
Product/equipment, performance or coaching technique?

In this session we are looking at….

Before you begin plan a solution

Once the problem is defined record what your collective solution is, this should be agreed between all parties (performer, coach and observer).

Describe the test environment:

Prior to testing: **THINK - Safety, Environment, Personal Care, Plan B**

Establish roles and test the solution

Record the roles of each person involved to enable to be solution to be assessed

Performer	
Coach	
Observer	

1

Designed to provide an introduction to the test this page intends to help the stakeholders consider the aim of the test and their roles.

The page also reminds all involved for the need to consider safety.

Product Review

Now undertake the activity Observations or reflections……
Record the results of the solution in relation to the problem Where relevant answer the questions below to enable a picture to be drawn of how effective the solution was.
Did each person involved in the test satisfy their roles?
No ☐ Yes ☐ (Define)
General feedback and comments Outline below comments and feedback from each member of the test team including any researcher/observers

2

This page attempts to identify the way in which each stakeholder has worked during the test and enables them to provide an explanation of what has happened.

Product Review

On a scale of 1-5 (1 low, 5 high), how well did the solution solve the problem for:			
Tester	Coach	Product	Other (define)

Did the solution create a new problem for:		
Perfformer:	No ☐	Yes ☐ (Define)
Coach:	No ☐	Yes ☐ (Define)
Product:	No ☐	Yes ☐ (Define)
Other:	No ☐	Yes ☐ (Define)

Did the solution reduce or eliminate the problem?	No ☐	Yes ☐
Did the solution cause more problems than it solved?	No ☐	Yes ☐
Does a new solution need to be found?	No ☐	Yes ☐

3

This page attempts to capture more detailed information concerning the success of the problem.

Product Review **Next steps - Redefine the problem** Once the solution has been reviewed identify the reduced or new problems for the next round of review Other references – tape number photo number…. For Office Use only 4	This page attempts to capture the next steps for the design or intervention process.

12.12.9. Questionnaire Responses

12.12.9.1. Focus Group Person 1

12.12.9.1.1. About You

1. Introduction

2. Just to confirm – a summary of you

In the space below please could you outline how you positively describe yourself?

Female, youngish (still!). Sense of adventure, up for most things but still exercising an air of caution!

3. In a little more depth

Name: SH

Age Range: 25-34

Can you read this sheet? Easily, with glasses

Can you differentiate colour contrasts? No

Can you hear me? Easily, without hearing devices

Can you reach over your shoulder as it to scratch your back? Easily

Can you transfer from this chair to the next? w/c user; easily, without aid

Can you pick up this pen with your left hand? Yes Right hand? Yes

Can you move this chair? Yes, with ease

Do you exercise outdoors? More than once a week

4. Anything else you'd like to tell us? No

12.12.9.1.2. Product Review Form

Product: Kayak Postural Support Tester: SH

Date: 30 July – 6 August Coach: TP

Location: North Uist Observer: SP

Before you begin define the problem

Define what is to be addressed/is the focus: seating support

Product/equipment, performance or coaching technique? Postural support for sea kayak

In this session we are looking at:

Fitting a postural support to allow greater activity in kayak

Before you begin plan a solution:

Use the modular footplate, ankle protectors, seat pad, active back support, spray deck

Describe the test environment and note any additional equipment:

Environment – calm and rough water. Secure and exposed coastline

Additional technical support required? No

Establish roles for the test

Performer To test equipment once fitted and provide feedback (positive and negative)

Coach SC

Observer SP

Now undertake the activity/test and record the results

Observations and reflections

Performer See comments below

Coach SC

Observer SP

Did each person involved in the test satisfy their roles?

Yes, see discussion

12.12.9.1.3. Discussion

The postural support worked well and is a huge improvement on the AQUABAC, firstly in size and weight and ease of travel (ie can be put in rucksack and taken on holiday!), and secondly in performance. Unlike the AQUABAC, which is a bit like sitting in a comfy armchair, this back support made it easier for me to begin to feel the boat and for it to be more a part of me. It was also much easier to fit in and out of a boat. One thing that could be developed would be some support around the hips, possibly attached to the back support which might give me better support when trying to do support strokes etc. (make the boat feel more a part of me) . Other things that might be worth looking at are inflatable tubes to put behind the seat instead of foam and also seating cushions.

On a scale of 1-5 (1 low, 5 high), how well did the solution solve the problem for Tester: 4

Did the solution create a new problem for the Performer: Yes

Support needed for hip

Did the solution reduce or eliminate the problem? Yes, reduce

Did the solution cause more problems than it solved? No

Does a new solution need to be found? Possibly

Next steps – Redefine the problem:

- Hip supports – there may well be commercially available hip supports that I can look at.
- Inflatable support behind back rest – given that I don't have my own boat I would quite like to look at a more mobile support.

12.12.9.2. Focus Group Person 2

12.12.9.2.1. About You

1. Introduction

2. Just to confirm – a summary of you

In the space below please could you outline how you positively describe yourself?

Positively? Hmm – not sure about that one!

I'm a wheelchair user with paralysis from waist down caused by illness rather than accident. Some weakness and paralysis of specific muscle groups in right arm/shoulder. Most function is possible for arms but is achieved by unusual use of working muscles. Joint pain and increased mobility of joints in upper body adds some interest. I am positively negative and love to paddle!

3. In a little more depth

Name: JC

Age Range: 25-34

Can you read this sheet? Difficult, even with glasses. Poor muscle control makes reading difficult for more than a few clearly laid out sentences

Can you differentiate colour contrasts? Yes

Can you hear me? Easily, without hearing devices

Can you reach over your shoulder as it to scratch your back? Easily (left) With assistance from other arm (right)

Can you transfer from this chair to the next? w/c user

Can you pick up this pen with your left hand? Yes Right hand? Yes with difficulty

Can you move this chair? Yes, with assistance for balance/other

Do you exercise outdoors? More than once a week. Need support due to risk of seizures

4. Anything else you'd like to tell us?

12.12.9.2.2. Product Review Form

Product: Sea kayak postural support

Date: 23-26 July 2005

Location: Kintail outdoor centre and local waters

Tester: JC

Coach: SC

Observer: SP

Define the problem?

Postural support needed to achieve and maintain appropriate paddling position in a sea kayak. Paralysis from waist level downwards means that effective balance and paddling is impossible without some form of back/lower trunk support.

Aim of adaptation would be to achieve a postural support system that:

1. Facilitates effective and sustainable forwards & reverse paddling

2. Allows the paddler to exit the kayak if capsized

With a secondary aim of allowing the paddler to adapt existing kayaking techniques to progress into intermediate skills (eg sculling/rolling/bracing etc)

Planned solution:

Use full plate foot rests, seat pad & postural support system to achieve correct paddling posture on land. Test on water. Check wet exit. Adapt modular support system to achieve optimum results (safe, effective and sustainable).

Test environment/additional equipment:

Initially tested and set up on land while sat in boat

Tested on flat water under supervision

12.12.9.2.3. Discussion

The initial system comprised of:

1. Full plate footrests with additional padding, and foam blocks to reduce foot movement from optimum position. Foot plates positioned to force knees to contact with sides of boat thus providing good boat contact and effective leverage.

2. Neoprene knee pads to reduce pressure/skin damage where knees contact kayak

3. Gel seat pad

4. Modular back support comprising:

Custom cut back panels: 2 rigid plastic sheets, 1 sheet closed cell foam

Side panels: 2 x foam backed plastic sheets

Initial system:

- Allowed effective forwards, backwards and sideways paddling
- Maintained a positive paddling posture
- Transmitted a minor edge and balance adjustments from working shoulder/chest muscles to boat via structural support
- Had a high degree of rigidity that – inhibited backwards lean, & prevented sufficient edge control by other means to achieve any body involvement in

off balance techniques – braces and sculling purely relied on paddle for support.

Due to my persistence in trying to use previously learnt edge and balance control techniques (involving positional adjustments of shoulders and upper body to control boat movement) rigid back support modules caused skin damage over a 2hr paddling session.

12.12.9.3. Modification 1

To maintain rigid brace facilitating forwards paddling & reduce skin damage the back panels were secured to each other and the neoprene & foam covers were taped to the back support to ensure that the rigid panels did not slip and run during a backwards lean.

12.12.9.3.1. Result of modification 1

Fantastically effective postural support enabling efficient forwards paddling. However, the increased rigidity of the back panels made dynamic boat control uncomfortably limited. The solution worked perfectly for forwards and backwards paddling in an upright position, but made bracing and edging entirely reliant on the paddle and arm strength – something that was not sustainable for me with limited arm strength and increased joint mobility and pain. This was an effective solution for a 1-2* paddler wanting to paddle efficiently on simple water, but was not suitable for an intermediate paddler with limited arm strength and overly mobile joints wanting to achieve dynamic balance control in rougher water.

Over time the rigidity of the support continued to cause skin problems due to having a particularly bony back!

12.12.9.4. Modification 2

Compromise efficiency of forward paddling in order to achieve more flexibility in balance and edge control. Remove some of the rigidity of back panels in order to reduce skin abrasion and increase flexible use of upper body in boat control.

12.12.9.4.1. Result of modification 2

Increased boat control particularly off balance.

Better skin protection and comfort.

Reduced efficiency of forwards paddling due to less rigid postural support, however sufficient rigidity remained to enable me to sit upright and paddle reasonably effectively.

Sufficient flexibility in back panel to allow buoyancy aid foam to pull body into moderate backwards lean to enable rolling.

Good compromise between rigid postural support and movement required to control boat edge in rougher water.

Happy paddler…. (smiley face)

Further suggested modifications:

Try padded semi-rigid plastic in back support to increase rigidity without inhibiting flexibility of edge/balance control.

12.12.10. Overall

The modular nature of the postural support was fantastic for experimenting with different levels, shapes and rigidity of support without completely reinventing the wheel.

A rigid, static support is ideal for getting paddlers on the water and progressing through 1 & 2* skills. It is very effective for basic paddling skills and provides significant balance and positional stability

If paddlers have good arm and upper torso control and no joint hypermobility/pain, techniques could be adapted to give fairly good off balance control using the initial rigid support. However this will rely on paddle positioning and arm strength to achieve off balance control.

Paddlers like me with some weakness in one or both arms, or joint pain/hypermobility will need to increase the flexibility of the postural support to facilitate alternative methods of edge/balance control once initial boat handling has been learned. This process will involve tweaking the back support to achieve the right balance between rigid support for the immobile lower body, and flexible support allowing sufficient upper body flexibility to compensate for reduced arm strength and to accommodate joint mobility without too much pain. A delicate balance specific to the individual would be needed to maximise paddling function & minimise compromise to postural support.

Overall this system enabled me to paddle and roll and is transferable between kayaks. It is possible to modify and adapt according to the type of paddling planned and to growing/changing needs/abilities.

A fantastic idea that has many potential applications and possibilities. Will certainly form the basis for any future sea and touring paddling. Thanks!

12.12.11. Summary of Results

Person 1 and Person 2 were both females, aged 25-34. Both were wheelchair users with good upper body mobility, though Person 2 had some limited strength on the left side. Both exercised more than once per week.

Person 1 was hoping to achieve more kayak activity by having a more effective postural support, while Person 2 wanted it to enable her to improve to an intermediate level, including to have more confidence with rolling.

Person 1 was able to test the equipment in calm and rough water, while Person 2 only tested it in calm water.

Both subjects were pleased with the postural support provided (once modifications had been made for Person 2).

Person 1 compared it to the AQUABAC, and noted its improved size and weight, and also that it was easier to fit. Further adaptations were suggested to increase support around the hips and provide inflatable support behind the back rest.

Person 2 liked its adaptability, to meet individual requirements for rigidity versus flexibility. She noted that the performance of the equipment was interfered with by her difficulty in altering her paddling technique to accommodate the alteration in her sitting posture. She noted that she would like to use the support for future paddling. Further adaptations were suggested to try using semi rigid plastic in the back support, to increase rigidity without compromising flexibility.

12.12.12. Participant Observations

12.12.12.1. Participant Observations of Person 1

SH managed an easy transfer in and out of the kayak.

SH was quite slight and required a lot of padding to get the boat to fit her frame, this is nothing to do with her disability or any postural requirements.

SH seemed to paddle well with the group and was able to participate in all of the coaching activities.

The modular foot rest solution seemed to work well here and was able to be adjusted to provide support regardless of the relatively short length of SH's legs.

SH seemed to want to gain information on the position of her legs on the water, due to the small frame of SH in the boat any movement of her legs in the kayak affected her stability by changing the balance.

12.12.12.2. Participant Observations of Person 2

JC is clearly a highly motivated paddler. In addition to her postural requirements there are a number of medical considerations which affected JC's participation in the kayaking course.

JC's ambition is to become a sea kayak coach and it was clear that JC's interaction with the sea kayaking coaches and other staff was intended to provide JC with information to successfully progress up the coaching ladder.

Energy levels were an issue throughout the kayaking and as with SH, JC's relatively small frame was an issue when JC utilised the standard Capella P and H sea kayak. Again I suggest that a smaller craft may be beneficial, along with a lightweight and shorter paddle.

12.12.13. Reflections

12.12.13.1. Reflection About Person 1

12.12.13.1.1. Experience

SH seemed to take to the new postural support very well and seemed comfortable with the donning and the general use. In comparison to SH's use of the AQUABAC during the previous year's field trial, SH seemed to be swamped by the size of the sea kayak, which was a standard Capella P and H sea kayak. The paddle which SH used was the shortest available in the standard equipment provided. The clothing provided was also the smallest available in the standard equipment. SH participated in all aspects of the sea kayaking activity during the week.

12.12.13.1.2. Express

I feel that the sizing of the standard equipment may have had a small effect upon SH's performance and experience of the sea kayaking. SH seemed a little swamped in the standard sea kayak, and I feel in hindsight that a sea kayak with a slimmer profile and smaller beam may well have been beneficial. If SH is to continue sea kayaking then I feel that it may be beneficial for SH to purchase a lightweight paddle of the correct length. I do not feel that this is any different from the needs of any sea kayaker, disabled or non-disabled.

12.12.13.1.3. Examine

SH's feedback on her posture seemed to be partially dependent on the ability to observe leg position and body position in relation to the seat base. The participants with whom I have worked previously have often expressed their sense of posture without the need for visual input. I feel that there is scope to evolve a range of markers for the participant to help them, or assist them, with understanding their posture more effectively.

The way in which a participant understands their posture may be linked to their learning style, i.e. visual, auditory, kinaesthetic.

12.12.13.1.4. Explore

This interaction revealed the need to provide methods for self feedback for the performer. It also revealed the need to consider the affect of standard equipment on the performance of the adaptive equipment and the performance of the performer as a whole.

12.12.13.2. Reflection About Person 2

12.12.13.2.1. Experience

JC managed to participate in the sea kayaking everyday.

Whilst out at sea and away from diesel fumes, JC performed all the activities, exercises and journeys requested or suggested by the coaches. JC was clearly exhausted at the end of the week, but remained determined to participate in every activity or kayaking opportunity possible.

The staff team worked exceptionally hard and managed critical incidents with grace and high levels of competence. It helped that all staff were either first aid trainers or wilderness emergency medical technicians with experience of rescue scenarios. This enabled the staff team to maintain a calm and measured front to the other participants on the course.

12.12.13.2.2. Express

I found JC difficult to work with. The pressure of her being relatively ill meant that she had to push herself very hard to be on the water for the longest possible time. This affected her relationship with those around her, including myself. It felt that her need was to use her energy to be on the water rather than contributing to feedback about equipment.

I also felt that a lot of my attention during our interaction had to be focused on maintaining her personal safety and being hyper-aware of any environmental factor that might cause her to go into a state of anaphylaxis. Having said this, JC did willingly try all of the technical solutions that were offered to her.

12.12.13.2.3. Examine

There was an anaphylaxis type incident everyday, usually on or near the water, which resulted in the administration of intramuscular injections and oxygen. The oxygen was stored in a hatch in JC's kayak, with backups being carried by all staff and volunteers. In addition to the anaphylaxis in the water there was usually a post supper anaphylaxis incident, which JC attributed to being a mild reaction to eating.

On only one occasion did we request the presence of JC's next of kin and put the Stornaway helicopter on standby.

JC disappeared on the first night, when we arrived at the accommodation on N Uist. A hasty search was implemented and JC was observed to be sitting looking out to sea. The search team stood down once they had found and observed JC from a distance, without letting JC know of their presence. On JC's return, JC suggested that this was the first time that JC had ever been alone in the outdoors.

JC refused to do the feedback face-to-face, saying that JC would present JC's suggestions upon return home. JC did do this and I found JC's feedback was possibly more detailed and thoughtful than that which I gained from the other participants, who filled out questionnaires at the end of the course before they departed.

12.12.13.2.4. Explore

Whilst I found it a highly stressful and exhausting interaction, I felt that it was valuable for both parties. This is therefore something I would be willing to do again.

I learnt more about logistics than anything else from working with JC. By gaining a really functional understanding about an individual it becomes possible to work with people who have relatively complex impairments.

12.12.14. Study Reflection

12.12.14.1. Experience

The study took place over a one week period, following an initial week of settling in. There were a variety of challenges that took place, mainly because I was involved in so many different tasks, other than my role as a researcher. Once again logistics, support for participants, co-ordination of coaches, equipment, and daily risk assessments and operations all required attention to facilitate the research.

12.12.14.2. Express

I found it extremely challenging to fill so many different roles; providing suitable environments, supporting staff, observing and gaining feedback from the stakeholders, and making jury rig adjustments to equipment. It was an exhausting but useful process to learn more not only about the equipment, but about research tools and methods.

The coaches and volunteers who supported the research were acting purely as coaches, unlike in Study 3 - Iceland, where the focus of the research was to look at the process and interaction between the coach and performer. In this study I did not state this to the staff, as I almost took it for granted. There was a conflict which I had not anticipated, between allowing the coaches to practice and directly involving them in the research process. This could be linked to my professional status within the outdoor community, making it difficult for the coaches to comfortably contribute.

12.12.14.3. Examine

The participants were able to provide useful feedback. The coaches however were perhaps less engaging with the process and were more concerned with the learning outcomes for the participants. They often deferred directly to me when discussing equipment, rather than attempting to input at a level that could be expected of a qualified coach.

12.12.14.4. Explore

The management of field-based trials needs to be considered, to ensure that the most is made of the research opportunity when there are limited resources available. This requires not only careful planning prior to the study, but also the creation of improved field-based collection tools. It also requires careful consideration of the staff team and the relationship between the researcher and each of the professionals within that team.

12.12.15. Study Conclusion

Study 10 evaluates the practical and methodological product of the previous studies and research involved in designing an adaptive seating device. Interviews, observations, a product review form and reflections were utilised.

The equipment was a success. It proved relatively easy to fit to two individuals with varying levels of spinal cord injury, both of whom reported an improvement in performance as a result of using the design.

The pro-formas worked well, and provided a good structure for discussion and feedback.

In practice it is challenging to maintain a harmonious programme of events while undertaking the fitting, helping to organise and also removing the environmental barriers to participation. The pro-formas therefore need to be designed in such a way that they do not require the involvement of the researcher at the initial time of completion. This requires the pro-formas to be written in sections which can be completed quickly, easily and independently, as close to the experience as possible.

In previous studies information needed to be gained from participants to start the design process. In this study the research had moved to a new stage: Now I have a product, how do I review it? This required the change from relatively informal processes, to using a more structured tool that others could replicate should they choose.

Additional elements to include in future pro-formas would be:

- Space for measurements
- Weather conditions and more environmental information
- When was the peak experience for the performer

One participant noted that testing of the equipment was limited by their ability to adapt technique to meet the new sitting posture. This goes some way to explaining the value of expeditions, where participants have such long journeys to do that they have the benefit of time to adapt their technique, creating a more effective test.

12.12.16. N Uist Images