A Proposed Conceptual Framework Aimed At Assistive Technology Development For Paracanoeing

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Introduction

There is currently limited information and guidance to help inform NGB's as to how to develop the high performance technology of elite athletes who possess limb absence. (Dyer, 2019).

Dyer, B, 2019. Development of high performance parasport prosthetic limbs: a proposed framework and case study. *Assistive Technology* (In Press).

Introduction

- *The potential grounds exist for assistive technology to provide a measurable mechanical ergogenic effect.*

Introduction

A conceptual framework for high performance prosthetic limb creation will be presented (based upon experience derived from the London and Rio Paralympic Games).

Starting Points

- Lack of guidance and information in the sports biomedical engineering field.
- Product design philosophy utilises design process guidance …….(but they are not currently suitable for the competitive sports environment).

Methods

- A proposed ‘Hanging Diamond’ model was developed, based upon applied reflective experiences and literature reviews (Dyer 2019)

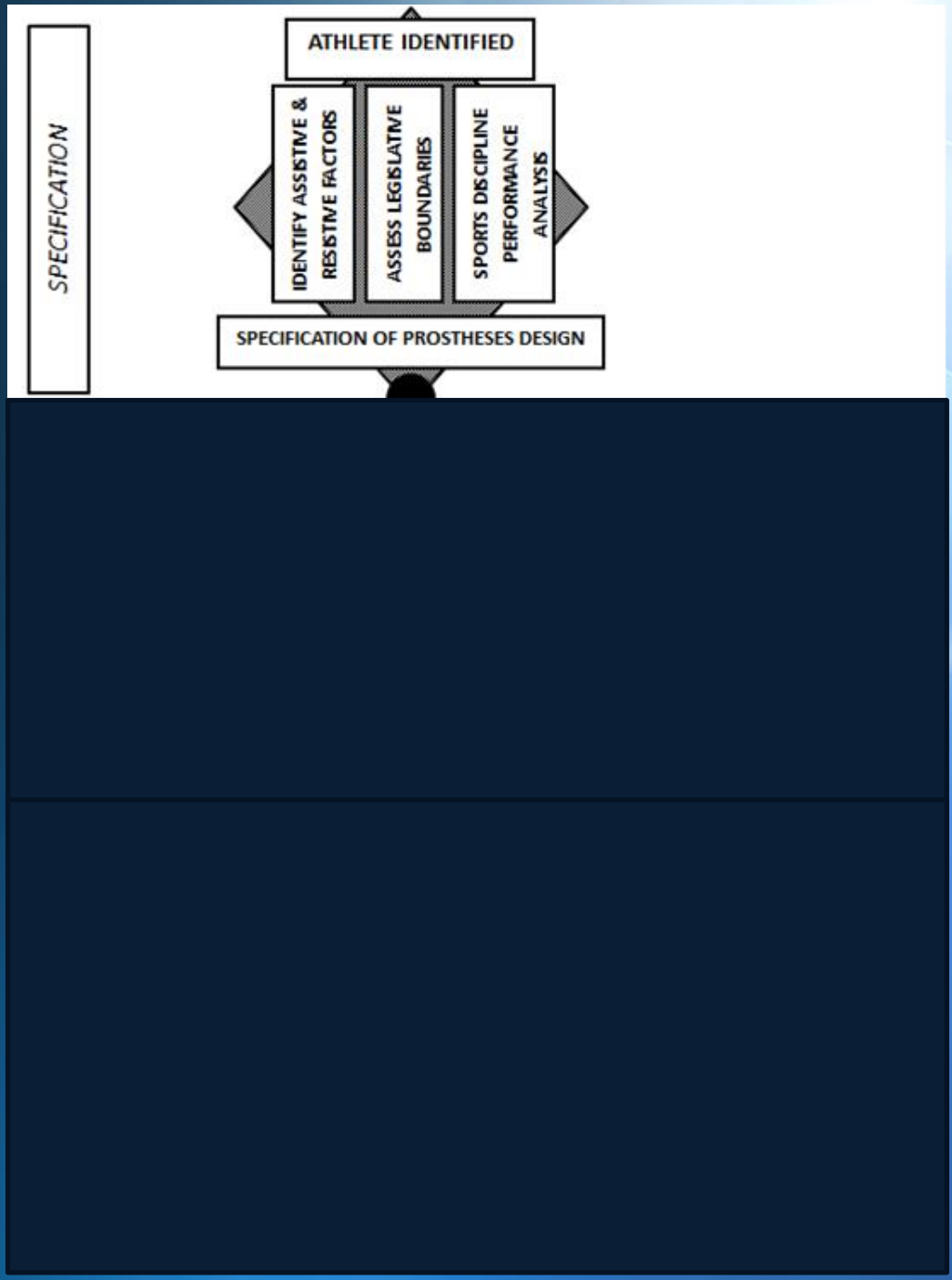
- This conceptual model was:
  - Conceived as a result of London 2012.
  - Applied to two elite athletes during 2016 at the Invictus Games and the Rio Paralympic Games.

Dyer, B, 2019. Development of high performance parasport prosthetic limbs: a proposed framework and case study. *Assistive Technology* (In Press).

2012 Design Realisation…….

…….but the process had problems.

The Model


SPECIFICATION
ATHLETE IDENTIFIED
IDENTIFY ASSISTIVE & RESISTIVE FACTORS
ASSESS LEGISLATIVE BOUNDARIES
SPORTS DISCIPLINE PERFORMANCE ANALYSIS
SPECIFICATION OF PROSTHESES DESIGN

Hanging Diamond Case Study: Cycling Prostheses Design for the 2016 Paralympic Games / Invictus Games

Bournemouth University

pace rehabilitation

Cycling Prosthesis Project

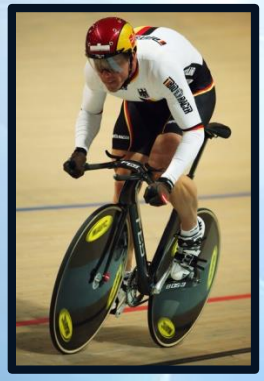
Brief: *To design a lower limb cycling prosthesis for elite-level paracyclists.*

1) For elite level athletes going to two Paralympic Games and the Invictus Games).

2) Using limited time and resources.

3) For the demands of multiple disciplines:- a track kilometre TT, the mass start road race and a long distance individual time trial.

Key Design Criteria



1) Mixed Race Objectives –

- *Track 1 Kilometre TT:* An event requiring an aggressive start and high power output for ~60 seconds @ ~600w

- *Individual Time Trial:* A long endurance event of 20Km+. Aerodynamic efficiency is critical. Effort = ~300-400w

2) The uniqueness of each amputee, their multi event preferences and their riding positions makes ‘off the shelf’ solutions unlikely.

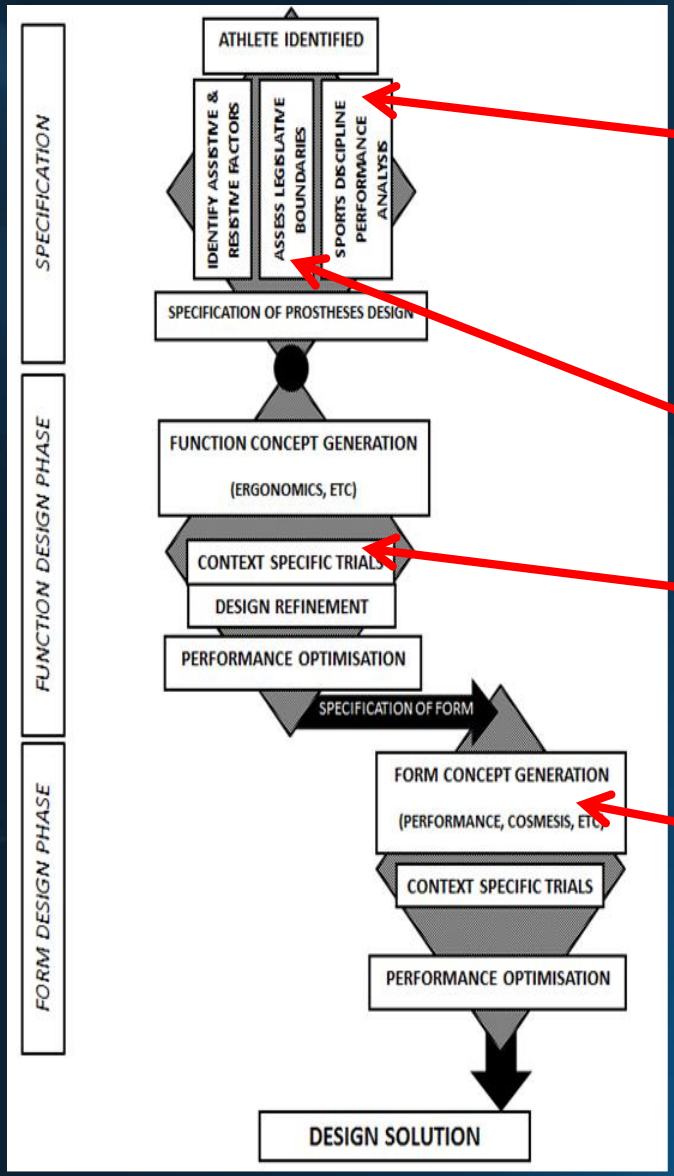
3) If performance is the aim, a prosthesis should not resemble the limb that has been lost.

Key Design Specification Criteria

- Reduced Weight – increased acceleration of athlete.
- Increased stiffness – efficient power transfer.
- Improved aerodynamic efficiency – reduced drag.
- Does not infringe current bicycle technology legislation.
- Covert approach to design realisation.

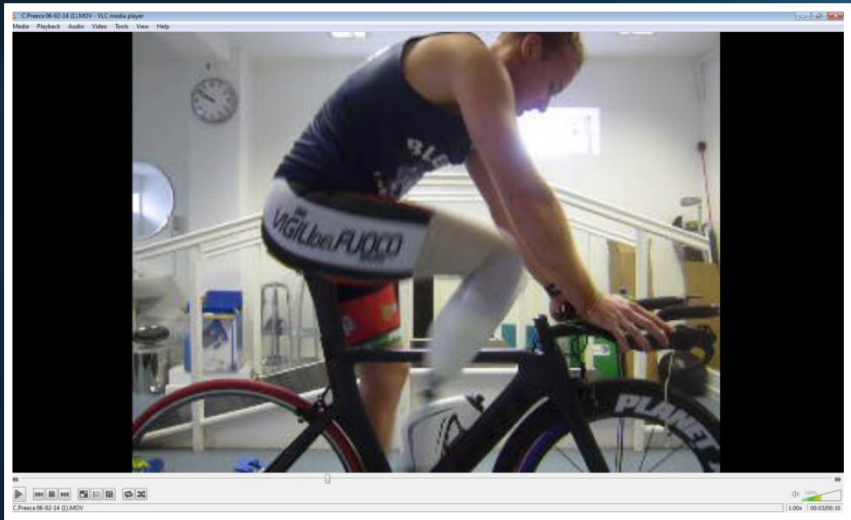
Note: For a successful application to Paracanoeing, a clear design specification must be identified prior to project start.

Hanging Diamond Process: 2016 Key Outcomes

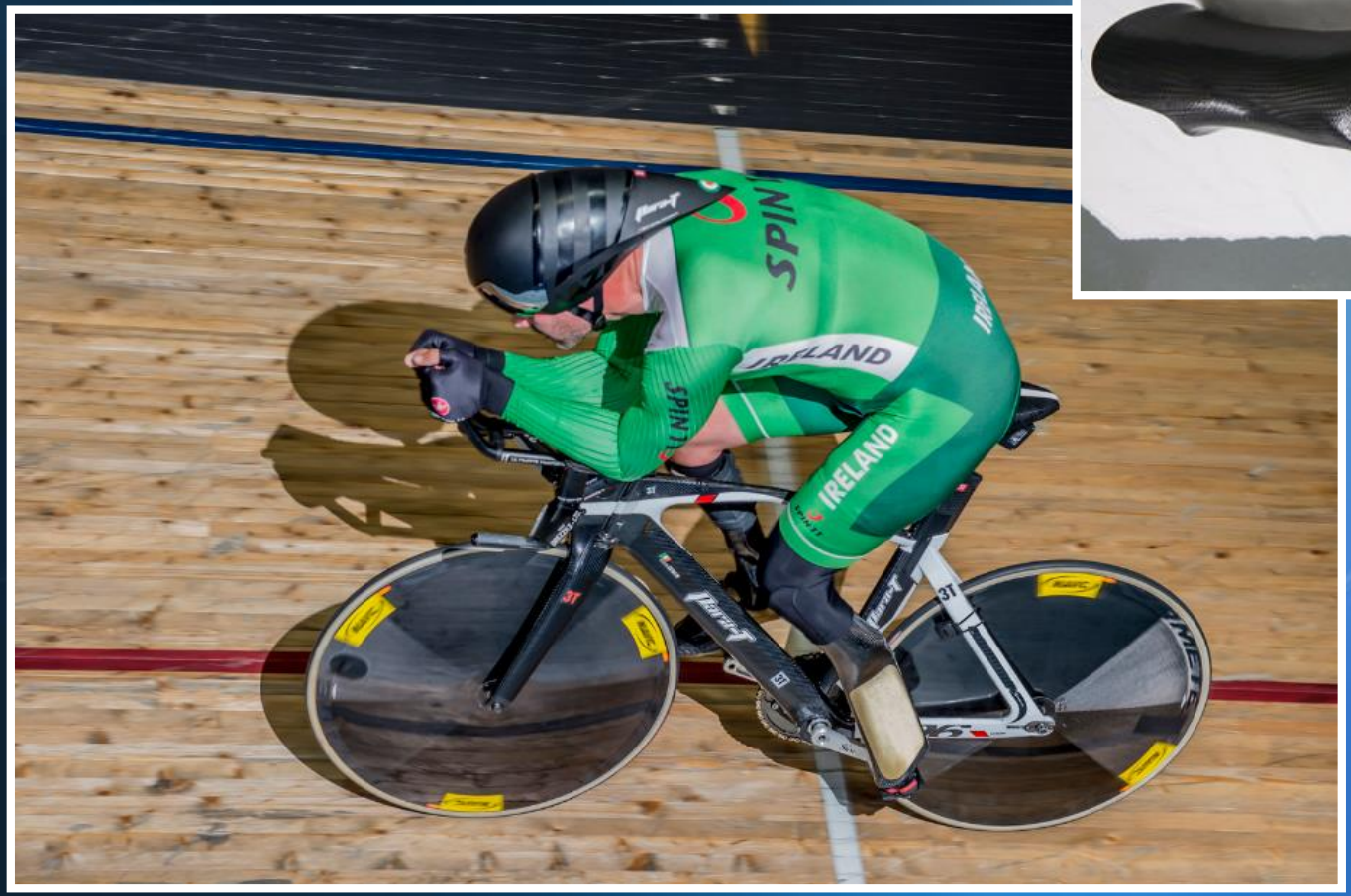


- Statistical analysis of event results revealed that the athlete classification were dominated by those using a prosthetic limb. Best scope for investment and medal success !
- Legislative rules analysis revealed loose/vague criteria and therefore allowed plenty of scope.
- Aerodynamic testing of a technology (never before evaluated) defined the best concept and a quantifiable performance enhancement.
- Personalised customisation of prosthetics builds a potential athlete-product positive relationship (Dyer, 2019 - under review).

2016 Design Realisation (1)



2016 Design Realisation (2)



Conclusions (1)

- Confidence of the proposed models design can be provided in that its philosophy adopts contemporary product design methodology.
- This value of the model to Paracanoeing may have some potential barriers as its multidisciplinary nature may mean that the traditional resources of prosthetic limb manufacture may not possess all of the skills required to fulfil it.
- The advantages of this model for Paracanoeing are that it provides guidelines and considerations in a field of study that has seen very little attention historically……

…… but will have increasing importance as performance improvements continue to be sought out.

Conclusions (2)

- This use of this model in practise provided the identification and utilisation of measurable performance enhancement in prosthetic limb design to athletes.

- The model is recommended to be applied to Paracanoeing to seek out any performance enhancement opportunities that may exist in its own sport.

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