Para Triathlon – The Interval Start System

World Triathlon is responsible for the rules and supervision of all Triathlon events under its control, including Para triathlon. These rules include the way the race is constructed, the disciplines, their distances, transitions and timing. For Para triathlon, there is an added complexity in that there are several Classes of athlete impairment, and those different level of impairment have differing impacts on the race times they can expect to achieve.

World Triathlon has developed an evidence-based Classification System for para triathlon that allocates para athletes into nine Classes, and initially this would imply that there would be nine different medal events for men and another nine for women. Running Para triathlon on a daily basis alongside the able body side of the sport poses many benefits and also many challenges at the same time, mainly due to race logistics such as available time frames for road closures, safe management of athletes on the course at the same time, venue availability and overall race programme on the given days. There are currently many limitations on sports to be able to have their complete medal event programme at the Paralympic Games. To address all the above-mentioned challenges, World Triathlon looked to other sports with a similar issue and introduced the Interval Start System (Similar to existing Factor Systems) to combine certain sport classes in the same medal event while considering the differing levels of impairment to ensure fair competition. **The outcome of this exercise is the use of the Interval Start System.**

The benefits of this approach are:

- The top levels of the competition are genuinely elite, with enough competitors able to rise to the top level

- More athletes with differing impairments are able to enter a competition in which they have the potential to succeed (chance to excel as long as they are well-trained)

- There is greater fairness because athletes are not excluded from the top events

- It is a more compact and spectator-friendly format that is also easier for the media to understand and broadcasters to host

- It is a more attractive spectacle

1. BACKGROUND

As Para triathlon evolved from the late 1990s, the number of classes were streamlined to 6 classes in 2004. At this time, the classes consisted of 1 wheelchair class, 4 standing classes, and 1 visually impaired class. While variances were observed in several classes, both the wheelchair class and visually impaired class demonstrated a need to level the playing field within these classes due to the different degrees of impairment. With classes B1, B2 and B3 previously determined through IBSA classification, the VI para triathletes were already assigned to those classes. The initial method to level the playing field for athletes from B2 and B3 was for blackout goggles to be used for these two classes. This concept was not supported by many athletes and team managers. Hence the ITU (World Triathlon since October 2020) explored other options to create a fair playing field for VI athletes.

ITU connected with Hugh Daniel, the individual who has calculated the factors used in IPC Alpine Skiing since 2007. Hugh Daniel used the same methodology to develop an interval start system for Paratriathlon as what was used in the IPC Alpine System and Nordic Skiing that has been validated through the years as an evidence-based mechanism for staging para events. The new interval start system was introduced in May 2014 for Visually Impaired athletes and in 2017 for PTWC (wheelchair) athletes in para triathlon and has been used since.

Mathematical Methodology

The Interval Start System used by World Triathlon is based on the original work of Ing. Niko Moll in the early 1990s and the similar technique developed at the University of Vienna.

That mechanism used a quadratic mathematical formula based on best results in each sport class and was applied shortly after to IPC Alpine Skiing. In 2008 further developments to this system took place and several modifications were provided in a paper by Prof. D. Percy and B. Warner to improve the calculations and to provide a formal mathematical basis for the process. This work was then taken over by Hugh Daniel (AUS) until the present. So the methodology has a proven track record.

The methodology involves the selection and comparison of elite race results where the objective is to compare the cohort of elite competitors in each sport class. For example, in the PTVI Medal Event we compare the median race performance of the B1 (PTVI1) Class against the median race performance of the B2/B3 (PTVI2/3) Class. The comparison is calculated as a ratio to the winning results for the B2/B3 sport classes. All results are represented as a fraction of the winning result for the B2/B3 Classes. This ratio is calculated for the total race time.

The ratio is also calculated for the 5 segments of the race (Swim, T1, Bike, T2, Run). For VI, the bike segment proved to be irrelevant in performance and is discarded for calculation purposes.

The median ratio between those B1 (PTVI1) performances against the B2/2 (PTVI2/3) performances is calculated from the results of international competition events. This ratio is then applied to an expected total race time, which derives an interval start time value.

2.   Principles

- The Factors represent the expected performance of a given sport class, rather than individual athletes (that could be outliers)

- Outstanding athletes should not be penalized for their performances if they are exceptional athletes by making their factor more difficult

- Less capable athletes or athletes that are not well-trained should not be rewarded by an easier factor

- Classification assesses the impact of impairment for a given activity; the Factor is a value that can calibrate different sport classes based on (s the calibration of the Classes from) real race results

3.   How are the different interval start times calculated?

First, we use specific values called Factors, which are numbers that are less than or equal to one. In its simplest form, the factor is multiplied by the athlete's race time (clock time) to arrive to an adjusted (calculated) time. Because the Factor is one or less, the calculated time is either the same as the real clock time or is less. The greater the athlete impairment is, the lower the Factor will be.

For example:

- Athlete A is in Class X, which has a Factor of 1.0000

- Athlete B is in Class Y, which has a Factor of 0.9000

In a race,

- Athlete A completes in 1 hour 3 minutes and 15 seconds (3,795 seconds)

- Athlete B completes in 1 hour 10 minutes and 26 seconds (4,256 seconds)

- Athlete A is in Class X, so his/her calculated time is 3,795 x 1.0000 = 3,795 seconds

- Athlete B is in Class Y, so his/her calculated time is 4,226 x 0.9000 = 3,803 seconds

- Athlete A still wins, but the margin is only 8 seconds.

This mechanism by itself works well for disciplines where athletes compete against the clock, like time trial events (as in para triathlon, ski racing) in which each athlete has his/her own time and is timed separately. In Para triathlon, the first athlete across the line is the winner. To achieve this, we use an Interval Start mechanism.

4.   What is the interval start?

In Para triathlon we combine certain sport classes into a single race (single medal event). This makes it easy to conduct the lead-off at the start so that the first athlete crossing the finish is the winner. The Sport class with the highest activity limitation (more impairment degree) starts first, and the other Sport class/classes starts after the calculated interval. This interval to determine the staggered start is calculated by dividing the expected race time by the Factor to determine the difference for the more impaired Sport class. This difference is the Lead-off Value.

For example:

- Class X has a Factor of 1.0000 and Class Y has a Factor of 0.9000.

- The expected race time is 1 hour 4 minutes and 30 seconds (3,870 seconds)

- The Lead-off for Class Y is 3,870 ÷ 0.9000 – 3,870 = 430 seconds (7 minutes, 10 seconds).

5.   How are the factors determined?

The Factors are calculated based on the actual real time performances of a large cohort of athletes in elite competition.

Race winners are considered "statistical outliers" in that their performances could be exceptionally outstanding, and their performances do not necessarily represent the performance of the Class in which they have been classified. By using Median performance values, we obtain a mathematically robust measure, which provides a meaningful comparison tool amongst different sport classes.

6.   Process

We examine all the elite races over the past 2 or 4 years (the Paralympic cycle), discarding those races where there were exceptional circumstances, such as a small number of participants, shorter distances in either swim, bike or run and calculate a Race Factor for every participant.

Athlete Race Factor = Winner's Real Time ÷ Athlete's Real Time

Another way of putting it is that we calculate what Factor the Athlete would have needed to equal the Winner's time. We then have a large number of measured Race Factors which we then

assign to the Class of each athlete. We then calculate the Median Race Factor for each Class and from that we can determine the Factor value to be used to compare the different sport classes.

While this calculation is quite robust, we also apply a smoothing process by comparing the Calculated Factor to the historic factor used the previous year and applying a weighting the new value.

As Men and Women compete on the same course, we combine their times using a performance ratio. The fastest Men are in general consistently faster than the fastest women, **but there is no evidence to show that the impact of the impairment is any different between men and women**. As a result, we use a similar methodology to calculate a Men/Women ratio to scale the women's results and thus make them comparable to those of the men. This has the added advantage of increasing the size of the field in each race.

7.   How is the interval start lead-off determined?

The purpose of the interval start is to adjust for the effect of the difference in impairment between Classes at the Race Finish. If we apply the Factor to the total time we expect the race to take, we arrive at a time difference that we can use for the lead-off. Though Men and Women have the same Factor, the race time of the winner is different, and this is why the interval start lead-off is also different for both genders.

For example:

- Class X has a Factor of 1.0000 and Class Y has a Factor of 0.9000

- Say the Winning time for the men in Class X is 1 hour 4 minutes = 3,840 seconds

- We calculate the lead-off as 3,480 ÷ 0.9000 – 3,480 = 426 seconds (7 minutes 6 seconds).

- Similarly, if the winning time for the women in Class X is 1 hour 17 minutes = 4,620 seconds

- We calculate the lead-off for the women to be 4,620÷0.9000 – 4,620 = 8 minutes 33 seconds.