THE INCREASED PERFORMANCE DENSITY AT THE TOP OF MANY traditional elite sports has started to cause major challenges when comparing performances of athletes and deciding on winners. For example, performance differences between athletes are increasingly often within the error margins of the measuring systems, making it impossible to determine the winner.

The challenges lay not only in comparing results during competitions, but also in determining the selection process of who gets to compete in the first place. In the case of Dutch Olympic speed skating, the pool of highly competitive athletes is large. Because only a limited number of athletes is allowed to represent each country, the Olympic selection process is a precarious affair.

Just before the 2010 Winter Olympics in Vancouver, we learned about the selection challenge facing the Royal Dutch Speed Skating Federation (KNSB). We offered our ideas for a decision support system that can aid in finding an “optimal” selection with the highest probability of winning medals to the federation’s sport director Arie Koops. It took more time to obtain his email address than to convince him of our ideas. Indeed, he was immediately excited, and from that moment we have been closely involved in the Olympic selection process of Dutch speed skaters. Bertus Talsma was appointed by ORTEC in 2014 to lead the development of said decision-support system.

The cooperation of the University of Groningen, ORTEC Sports and the Royal Dutch Speed Skating Federation has resulted in a system that is now broadly supported by both the athletes and the federation’s supporting staff. Legal challenges to the selection decisions, previously troublesome, are now a thing of the past. During the last two Olympic Winter Games – Sochi (2014) and PyeongChang (2018) – the Dutch squad reached Dutch Olympic Committee technical director Maurits Hendriks’ objective of achieving the top five on the Winter Olympics medal table (Figure 1), with 23 of the 24 medals in 2014 in speed skating, and 16 of the 20 in 2018.

Selection Precariousness
During the Olympics, the Netherlands receives 38 “speed skating starting positions” – 19 for female and 19 for male skaters – across seven events, namely, for 500 (3), 1,000 (3), 1,500 (3), 3,000 (3) and 5,000 (2) meters for women, and...
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500 (3), 1,000 (3), 1,500 (3), 5,000 (3) and 10,000 (2) meters for men. (The number of starting positions is listed in parentheses.) The recently introduced mass start competition allows two Dutch skaters for both women and men, while three skaters comprise an entry in the team event.

For each event, the Netherlands has a large pool of potential medal winners, but only 10 female and 10 male speed skaters are allowed to represent the country. Because the number of starting positions exceeds the number of skaters, some skaters will need to compete in multiple events, and it is therefore not necessary to select the best athlete for more than one starting position. We could restrict ourselves to six events, because the team pursuit members have to qualify for the distance event first. To reach the top 5 in the Olympic medal table, it may be optimal to select “generalists” rather than “specialists.”

It is worth noting that this contrasts with how the World Single Distance Speed Skating Championships (WSDCh) are organized. This event has the same program as the Olympics, but the number of starting positions equals the number of participating skaters. In this case, the selection problem is straightforward; simply select the highest-ranked skaters of the tour of the tournament for each separate event, which is in fact how it is done in practice. Obviously, a solution for this selection problem strongly depends on the choice of an operational translation of “reaching the top 5” objective and satisfying the above quota restrictions. We have chosen to calculate “Olympic medal winning proba-

Gould’s Analysis of the Performance Congestion

Why are the performance differences at the top so small today? Although we probably all perceive elite athletes running faster and jumping higher (see, e.g., [1]), it may be less well known that the differences between the top performances have started to decrease over time. An interesting paper by Haake et al. [2] contains graphs of eight classic field events, showing that after World War II the “performances have grown incomparable. This has already happened more than once in practice. For example, the Dutch speed skater Koen Verweij lost the 2014 Olympic gold medal for the 1,500-meter race against a Brónka from Poland with a difference of 0.003 seconds, well within the error margin of the official measuring system. In our opinion, both athletes should have been awarded a gold medal; according to the official timekeepers, such a difference is indeed within the error margins and therefore insignificant.

An Ambitious Academic Solution

As previously mentioned, the leading objective of the Dutch Olympic Committee is reaching the top 5 in the Winter Olympics medal table. To make this objective computable, we did what O.R. professionals always do: collect data, design models and algorithms, and apply scenario analysis for analyzing the stability of the solution in relation to possible uncertainty of the data parameters (e.g., importance weights). A crucial ingredient for the optimization of the number of medalists was to answer the question: What exactly do we mean by “winning probabilities” and how do we estimate them? For this purpose, we used a linear optimization model. Its basic input ingredi-

To the 2014 Winter Olympic medalists...
Speed Skating Race was organized more than 24 years ago (one of the participants was Gerard Sierksma), speed skating is still in the collective memory of the Dutch. Indeed, the speed skating trials attract paid ticketholders for four days of full stadiums.

How could we incorporate the trial results in the decision-support system? Koops’ proposal was to entered using no other names than the ones already entered with the name of the skater that finished first can be completed. The first position of the ranking is probabilities that the Netherlands wins a medal. The performance matrix. This choice is certainly questionable because the matrix contains person values, whereas the selection ranking is based on country values, i.e., probabilities that the Netherlands wins a medal. The reader is challenged to provide a better choice.

When the trials are finished, the selection rankings can be completed. The first position of the ranking is entered with the name of the skater that finished first on the distance of that first position, and so on. As soon as 10 different names of skaters have been entered, then the other positions on the selection ranking are entered using no other names than the ones already filled out, taking into account the rankings of the trials entered. It should be noted that the Federation has the right to deviate in a motivated manner from the outcome of the procedure. This may happen, for example, when a “highly valuable” skater – say, for the team pursuit competition – becomes sick just before the trials. The procedure serves as a decision support system.

High Expectations and Disappointing Realizations

Selection decisions are based on current expectations. Nobody knows ahead of time how athletes will perform during a race. Just like in all facets of life, in sports, high expectations usually lead to high interest of the media, sponsors and of course the fans. But it can also turn out differently. High expectations can lead to major disappointments, and low expectations to surprising realizations. The following two events are examples.

Vancouver 2010 Olympics.

The great Dutch male speed skater Sven Kramer was destined throughout Holland to win the 10k in the longest Olympic speed skating distance. Not only did he have the highest winning probability (100%) in the performance matrix, he was also No. 1 on that distance during the December trials. With just a quarter of the race to go, his lead on the next skater in the Olympic race was practically unbridgeable. It took a split second to destroy all sky-rocking expectations; Kramer took a wrong turn (during each lap skaters change lanes) and was disqualified for riding in the wrong lane during the final laps. Despite two more attempts, Kramer never won the Olympic 10k beyond 2010.

Heerenveen 2017 trials.

On the final last day of the Olympic trials, the last distance race was the women’s 5k. Being surrounded by “royal” speed skating directors on the grandstand in Heerenveen was not only a privilege, it was also revealing. Our grandstand directors on the grandstand in Heerenveen was not only a privilege, it was also revealing. Our grandstand directors argued that this last race was redundant in regard to the selection ranking. The two women skaters preparing for their race were considered to have no chance to enter the selection ranking. We knew better; our calculations showed something else. One of the skaters, Esmee Visser, had a high value in the performance matrix and in our optimal integer linear model solution. About two months later, she was the glorious winner of the 5k Olympic gold medal.

 Cooperation for Contribution

In the hectic world of elite sports with small performance differences and limited number of starting places for competitions, selection procedures must be carefully carried out with broad support from the athletes, their accompanying teams, the media and the fans. Otherwise, legal challenges are to be expected. Indeed, selection procedures must be legally watertight. And, maybe equally important, they should be controllable and repeatable, in the sense that when the procedure is repeated later, the result does not differ. During the more than eight years of cooperation with ORTEC and the University of Groningen, the Dutch Olympic Committee has not faced any major legal challenge on its Olympic selection decisions [7]. The stands of the popular speed skating trials are expected to remain full, because the expectations for Dutch Olympic success on the ice will remain high. Hanseke Brinkers’ [6] finger in the dike will not protect the Dutch against the consequences of the melting ice on the poles and the suffering iceless winters. The artificial ice in the 19th (!) speed skating rinks behind high dikes is the Dutch answer to this aspect of climate change. Our contribution was small in this respect, but certainly more effective than Hansje Brinkers’ finger.

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REFERENCES


The Netherlands women speed skaters won silver in the ladies’ team pursuit competition at the 2018 PyeongChang Olympic Games. Team Pursuit members included (l-r) Antoinette de Jong, Ireen Wüst, Marrit Leenstra and Lotte van Beek. Source: Martin de Jong.