Technology Driving Changes in Competitor Decision Making and Match Management

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Abstract

The main aim and focus of this work is to examine the impacts of the differing information technologies, currently used in sport, are having on the competitor's decision making processes and their match management. One Olympic sport which is currently introducing mandatory decision making technologies to the scoring processes was examined through discussion groups and interviews. The participants in the study had all participated and competed from the grassroots level to the elite level in Taekwondo, and exposed to various 'officiating' technologies as the technologies were being adopted by their sport. The findings present that, in the majority, the differing degrees of information technology being employed does impact on the athlete's decision making process and the individual's match management. When information technology is being used to provide a mechanism to ensure the correctness of officiating decisions, the outcomes of the matches can be additionally affected by the athlete's ability to adapt to the technology as well as the situation. The diligent use and application of appropriate technologies can be used as an effective aid, but it does come at a cost. Since the introduction of the use of decision making technology, the way the athlete prepares and competes in a match has changed. The findings provide a basis for further studies and examination of the impacts of the introduction of information technologies into other sports and as a transformer of sport.

Keywords: Decision making, information technology, match management

Introduction

As the decisions made by a referee or umpire can affect the ultimate outcome of a game, equally the same applies with decisions made by athletes during competition. In some situations the direction of the game can be changed by a single decision. Acording to Price (2006) and Connelly (2003), it is not uncommon for the referee or umpire to be identified as the cause of the failing of a player or team, and to be blamed for influencing the result of a game by either not enforcing the rules or being biased (Price, 2006; Connelly, 2003). Similarly, the decisions that an athlete takes, though not always identified, can also be the cause of failure or success.

Many players, however, do not understand the demands for split-second decision making and "mastery of the rules" (Mascarenhas, 2005). During a match, the athlete is required to evaluate the important characteristic of an event or situation, and respond with an appropriate and correct decision in about 1 second (Jones et al, 2002). Athletes have to respond almost immediately to events in a game that unfold dynamically and which may have many nuances, ambiguities and uncertainties (Mascarenhas, 2005). In general, the elite level athlete is required to make rapid decisions while also assessing multiple alternatives and strategies to respond to a single situation.

In recent years, there has been an increasing use of information technology in a growing number of areas of sport. This includes information technology to support or replace the referee's decision making, to support or enhance virtually all areas of athlete management, and to assist in the athlete's decision making during competition. For example, virtually all aspects of an athlete's preparation and training is monitored and affected via some form of technology. During competition, information technology is used to assist the competitor's decision making, where for example, coaches using information technology to scrutinizing game patterns and opponent's decisions, to then provide optimal advice to the player for the next play or remainder of the match. In addition, there is considerable investment in the use of information technology to support the athletes, the general media, and the development of precise scoring mechanisms (Ford et al, 1999).

Such is the current situation, that the elite, high profile sports are now turning to IT to provide tools, mechanisms and processes which can be used by athletes and coaches as an aid to provide maximal options for their athletes to make their "correct on field" decisions. This paper presents research into the

decision support technologies used in the sport of Taekwondo. The discussion of the findings shows that the types of IT decision making technologies used in competition will impact on the athlete's decision making processes, and the individual athlete's preparation and match management.

Research Method

The study was conducted through discussion groups and a series of interviews. The advantage of doing a qualitative research was that it allowed greater understandings of the interviewees' personal constructs and experiences. All participants in the study were fully informed and voluntarily consented to their involvement. Participants were also free to withdraw from the research without giving reason or justifying their decision at any time, if they so wished.

The sport of Taekwondo was indentified and examined due to its rapidly increasing introduction of IT related decision making technologies to minimise the likelihood of officiating errors, validation of scoring and the immediate correction of errors. Since becoming an Olympic sport, the sport continues to grow rapidly, currently has 191 member counties in the world governing body (World Taekwondo Federation – WTF) and is among the top 10 of International Sports Federations. The sport is currently contested globally at the amateur, semi-professional and Olympic levels.

There are currently several information technologies being used in Taekwondo for the capturing of points. These consist of electronic body protectors ("hogue"), which automatically record scores according to contact and preset criteria, or by scoring systems where points are sighted by the judges and recorded via electronic hand devices; as well as the management of game score and time. There has been and is considerable emphasis and pressure by the world governing body for the development and adoption of electronic scoring mechanisms to replace the scoring functions presently performed by the judges and to adopt technologies to allow instant review of play and decisions by officials.

This study only focused on those information technologies incorporating some degree of decision making and used in the actual game management / refereeing process were considered.

Discussion Groups

Two sets of informal discussions were held. Two discussion groups were held prior to the interviews and one following. To establish a framework for the discussions the following base definitions were employed:

- "Competing" is defined as contesting a sport where there exists the "observance of the rules, respect for the opponent, and combating violence and unfair behaviour" (IOC 2007). The approach to fair play in sport represents the positive benefits of playing by the rules, using common sense and respecting fellow players, referees, opponents and fans (FIFA, 2007).

- "Information Technology", due to its potentially broad definition, was referred to as both the hardware and software used to store, retrieve, and manipulate information currently used to aid or assist the official in the performance of their officiating duties during a match. This definition was also extended to include devices that are also used by any third party officiating in the determination or application of the rules and regulations of the sport for a particular match, and devices used by an athlete's coach or coaching team in competition or competition management.

- "Athlete" and "competitor" were identified for the purposes of this work, as those participating in structured, formal competition

- "Officiating" is defined as involvement in the application of the game rules and regulations during the contest – this included on- and off-field referees, umpires and sighting commissioners. The National Association of Sports Officials (2007) states that this includes the obligation to perform the expected (officiating) duties with "accuracy, fairness and objectivity through an overriding sense of integrity" (NASO, 2007).

- The words "referee" and "umpire" were synonymous, as were "game" and "match". This principle has also been adopted for this paper.

- There are considerable, and varying, definitions of "elite". With respect to this work, elite was defined by Garcia (2001) as competitive sport at the top level of the particular sport and where the

referee has the competencies due to a thorough understanding of the rules and experience to be at the top end of a "very high hierarchy" of sporting officials (Legrand, 2006).

Pre-Interview Discussions

An "interview guide" approach was implemented with the pre-interview discussions, containing issues to be addressed by the participants. As suggested by Patton (1990) this approach allows other related topics to emerge which may be specific to the individual participant. The discussion topics were asked in an open-ended fashion in order to "minimize the imposition of predetermined responses when gathering data" (Patton, 1990).

Specific questions related to any issues were not developed, but rather a general discussion mode focusing on the base definitions was employed to allow participants the ability to "word questions spontaneously" and "to establish a conversation style" (Patton, 1990) with the author, while maintaining focus on the topic. In the course of the initial discussions, new perspectives and related topics emerged, which were also investigated. Follow-up phone calls were made to two participants where further confirmation of information was required.

Interviews

A general interview script was developed based on issues derived from comments and points raised in the first set of informal discussions. The same main format of questioning was employed in all interviews. All the participants had competed at senior levels in Taekwondo, up to and including international competition. McCracken (1998) discusses how interviews can draw on the past as well as the present to extract a deeper understanding of an issue than a simple survey type inquiry. Erlandson (1993) states that the use of semi-structured interviews allows the investigator to ask respondents for facts as well as gathering opinions.

The interviewed subjects were solicited through email or through chain sampling. Chain sampling "identifies cases of interest from people who know people who know people who are information-rich, that is, good examples for study, good interview subjects" (Patton, 1990). All of the 26 volunteers were chosen for interview on the basis of availability, suitable experience and use of technology in their chosen sport (Taekwondo). Erlandson (1993) suggests that this technique of "purposive sampling" is preferred to random or representative sampling because the major concern of the researcher is to maximize discovery of the problem and the heterogeneous patterns that occur within the context of the particular study. Semi-structured interviews were conducted either at a location that suited the interviewee or at the interviewer's office. In general the interviews lasted about 40 minutes.

The focus of the questions centered on the views, if any, participants had to the uses of information technology and the impact of the use of the technology in relation to their play and decision making in Taekwondo. Any views or opinions in relation to another sport or technologies not employed by their sport were disregarded. Participants were also asked about their own adaptation to the use of the technologies, changes to their own practices leading up to, during and after a match. Their personal viewpoints on information technology, in relation to levels of application and introduction, what they enjoyed or did not enjoy with the use of the technology(s) employed in the sport, and what aspects they had or had not appreciated were also explored. The interviews were recorded and transcribed for analysis. Follow-up phone calls were made to six respondents where clarification or further investigation was required.

The interview transcripts were analyzed using constant comparison and analytic induction methods in order to identify and extract common themes across participants (Robinson, 1951; Lincoln and Guba, 1985). First, the data for each interviewee were reviewed and themes identified, and the themes from each were then compared and contrasted. Common themes were identified and the data re-examined with regard to these data categories.

Post-Interview Discussion

The post interview discussion was held with four participants in addition to the author. All participants are actively involved in Taekwondo in Australia, and currently compete, coach the sport or a combination of these.

Using the data drawn from the interviews, potential applications and variances of IT were identified in relation to the athlete making decisions during competition. These were based on recording of scores, issues surrounding the scoring of points from the perspective of both the athletes and the officials, the impacts on foul play, reducing or eliminating illegal play or tactics, ability to assist in the correct application of the rule(s), ease of use, the provision of a fairer competition, benefits or improvements to player performance and determining the correct result. Specific or branded technology was intentionally not identified, but rather the type and applications of IT being used was discussed, and the impacts from the player perspective in a Taekwondo match were identified.

The discussion was unstructured and free formatted. A primary general focus was on the introduction of information technology to sport at the elite level. Discussion then centred on the sport of Taekwondo, and the reception of IT by the athletes with respect to improving scoring points, tactics and match management. Discussion also included the ability of information technology to assist referees in their decision making and correctness of their decisions. The discussion also revealed additional considerations not earlier identified in relation to perceived attitudes to the use of IT. Individual responses to the discussion were analyzed, and themes were identified, and where common themes existed the data was re-examined with regard to these data categories.

Findings and Results

The sport of Taekwondo has gradually introduced differing levels of IT where electronic scoring devices were first being used in elite level competition in 1995. However it has only been over the recent few years that decision making technology has been used, with its first official use at a major international competition in 2009. Differing technologies with differing protocols have been used or trialled (see Table 1). The criterion for the application of the technology to a competition also varied and, as was in many cases, due to various external constraints such as availability, costs, etc, and in some cases was dependent on the economic situations of the organization and available funds.

With respect to the athlete and the impact; exposure and uses of the types of technology were dependent on the availability of funds, appropriate competition, and the organizing committee/host of a particular competition. This in turn did put some limitations to the set(s) of information technologies that an athlete had exposure to. In general, the set(s) of technologies an athlete had competed with was sufficient for the study at this level.

The impacts of information technology in the athlete's decision making and match management fell under either all or some of the following three categories, and are supported by comments received during the interviews and post-interview discussions:

A. Type of scoring technology

Prior to the introduction of technologies, scoring was performed by judges who recorded scores via pen and paper. These scores were assessed via a form of averaging to determine the score at the end of each round, which was then publicised. In the early 1990's Taekwondo commenced using electronic hand held scoring devices. These devices were used by the judges who scored points by depressing buttons when seeing a score. If the majority of the judges viewed the score and registered it within one second, the score was then deemed to be a legitimate score and the point was given to the athlete. Even with this early introduction the players decision making and match management was being affected by the electronics.

> *When it first came in, I would try a technique and immediately try to tie up my opponent so I could check the score board to see if the judges would score it. If not, I'd have to try something else. Whereas before I just kept going as I had no real idea if I had scored or not until the end of the round, and even then I wasn't 100% certain which technique was the scoring one or not.*

Decision making technologies were trialled in 2008 and introduced into the sport in 2009. With this type of technology, techniques to the body are automatically scored via the body protector ("hogue") worn by the athlete. There are currently three products being used (see Table 1) which have different scoring mechanisms. Scores for techniques to the head continue to be scored by the judges. However, the technology developers are trialling head protectors with sensors to record scores to the head.

Technology	Technologies Used/Trialled
Hand held electronic devices	Various types Records scores as identified by judges Transmits either by radio frequency or via direct connection to a control box
Addidas (ESM)	Introduced in 2008 Records scores using information technology Operates on force Transmits scores using Bluetooth technology
Lajust (EBP)	Development of product commenced in 1982 Introduced in 2009 Records scores using information technology Operates under two different modes: Proximity based on closing an electronic circuit, or force Transmits scores using proprietary technology
Daedo (E-Pro/TruScore)	Development of the product commenced in 2002 Being introduced in 2010 Records scores using information technology Identified points on a combination of proximity and force
Video Replay	Introduced in 2009 Allowed for instant review of referee's decision, or Review of point scored/not scored Provide multiple views and slow motion

Table 1: Types of Decision Support Technologies used in Taekwondo

It was found that the athlete had to adapt to the type of scoring system used due to the way the system registered a valid score. It was also noted that even though an athlete would use a legitimate technique, which may have previously been scored by the judges, it may not score unless it was executed in a specific manner unique to the information technology.

> *… I had to change the way I'd kick. When the new [electronic scoring]systems came in, all of a sudden I wouldn't be getting the points I'd get in the past. I talked with some of the other athletes and found out that I have to change the way I kick to get the points. It changed some of the way I played and strategies I use.*

B. Real Time Results

Research continues to be conducted in some sports to develop or enhance technologies that will act in an advisory capacity during the match without the need to stop the match, but rather while maintaining the normal tempo of the game. Football (soccer) has been closely examining and testing the micro-chipping of the ball to signal a scored goal. In other sports, such as rugby, the side-line touch judges contact the center referee via microphones and earpieces without stopping play. This includes volunteering information to the referee on off-side, foul or illegal play, line calls, etc, as it occurs (Leveaux, 2009).

The decision making technologies now introduced in Taekwondo via the automated scoring systems, has addressed the issue of continuity or maintenance of the flow of the match to some extent. The scores are being automatically registered. With the more complex scoring processes, which may score more points, current information technologies have not been able to fully address this, and theses points are still registered by the judges. In some cases, the judges do so via the advisory assistance of the information technology.

> *… it's frustrating when I do a complex technique with a couple of kicks including a spin kick and the (information) technology can't identify the kicks. If the judges miss the spin kick there's a chance I could miss the point, and in a tight game the one point could cost me the game.*

However, the introduction of IT has been reasonably well received by players and coaches. It has been identified as providing a more even platform to compete and the subjective human element has been removed. Prior to the commencement of a match both competitors have their electronic protectors registered to the match management software and the appropriate and equal scoring level set for both players.

Even though I hate it when the system won't give me the points for what I know was a good kick and, if we weren't using the electronic protectors the judges probably would have given it, I know at least it's the same for my opponent – and I guess at the end of the day it's sort of fair for both of us.

Considerable trust has been put into the electronics, as the only area where decisions cannot be questioned is regarding points scored via the electronic equipment. All other points or penalties may be reviewed via a coach's request. This in turn has come at some price. As this decision making by the IT system does not allow for interpretations of the situation that would have been done in the past by a referee. Some decisions have now become clearly black and white, removing any latitude for the situation at hand; and in some cases having a totally different outcome.

It's amazing the number of times a referee now penalizes a player for kicking after kayelo (break), even when it's not really intentional. If the system registers the kick and it's after the ref has called kayelo – then its a gam-jeom (one point deduction).

Most felt that the introduction is betterment for the game, but the game has changed quite dramatically. The changes had been identified as either because of the introduction a specific information technology or via the introduction of additional complimentary or supporting technology. The game has evolved into a new sport over a relatively quick period, especially when one looks back to the sport being scored with pen and paper when first introduced as a demonstration sport at the 1992 Barcelona Olympics.

C. Support Technologies

Depending on the sport, there exists a mechanism where the referee may use a third party for the assistance in the declaration of a decision. This is typically in situations where a critical decision needs to be made which may affect the outcome of the match. Such instances are, for example, on a line call in tennis, the fall of a wicket in cricket, or the scoring of a try in rugby union or rugby league.

Video and video analysis software is used by a review jury during the Taekwondo match to resolve a request for review by a coach on either a score or a referee's decision. The referee does not have access to video to ensure the correctness of their decision. It can only be requested by the coach and within 5 seconds of the incident occurring, and basically may be on any decision or infraction, except points scored by the electronic scoring systems. These requests are bound by constraints as to the juncture in the play in which they can be made, and only under specific conditions. This now has given the coach to some degree more control, but potentially more responsibility in the outcome of a score or match. The coach may ask for as many video reviews as he/she wishes in a match, but looses that right once a request is denied.

The video system has been introduced to allow for transparency in decision making and a speedy resolution to potential protest situations. It has achieved the goal of addressing protests, however it has created the avenue for legal stoppages in the contest which have become both tactical and a hindrance to the flow of the match. As one of the interviewees commented:

The video is good as it fixes things on the spot, but the smart players and coaches also know how to use it to their advantage.

The "post-interview" discussion group addressed the uses of video review within the game of Taekwondo. Most felt that it was not really a win/win situation but rather a potential win/loose situation, as a match is very dynamic and to have a facility where a coach stops the flow of the match to check on a decision or potential decision, could be tactically disruptive. It was noted that even though the player is not permitted to call for a video review, players are now calling to their coach for a video review and in some instances specifically to interfere with their opponent's strategies.

However, this group did feel that the application of the immediate video analysis/feedback has now been accepted as part of the game and does have merit. Especially in contentious situations, such as when two players kick a scoring kick at almost at the same time in a Sudden Death round, the process involving immediate video feedback now provides the platform to confirm or even ensure the correct winner. They confirmed the importance of method and situations of use need to be clearly defined. This was probably best summated by one participant's comment:

The video is here and works well. There are rules on how to use it and my job when I coach is to make sure I use it to my player's advantage. I also think its great for those Sudden Death match

when both players kick, say one to the head [scored by judges] and a body shot by the other [scored electronically] to see who actually scored first to make sure the right person wins.

Discussion

Those interviewed and the discussions groups felt there was a definite place for information technology in the sport to assist in correct decisions and in the most, all favoured the concept of electronic scoring. However, it was generally felt that the introduction of IT to automate the scoring was not only affecting the way and the strategies needed to win, but was also transforming the sport to the extent that IT is driving the sport and not the sport driving IT. It was evident that some athletes were now entering competition based on the types of information technologies being employed as the technologies, or lack of, could impact on their potential performance; and some of athletes competing at the elite level (World Championships, etc) were no longer focused on training in the martial art but rather in the sport, and with the latter, in some cases specifically to the information technology employed for a specific event.

Interestingly, even though they were in favour of electronic scoring, all felt that the sport still needed to be officiated by a referee(s) – and not solely by IT – due to the myriad of situations and nuances that occur in competition which ultimately could not be interpreted purely by technology.

The participants currently competing in events which are using some form of "refereeing" technology, identified there is a learning curve and adaptation process to be met. Their individual success is also dependent on their understanding the roles and functioning of the information technology being used, the guidelines or regulations for its use being appropriately applied, and those officiating in a match using the information technology constructively, while allowing the athlete the freedom in their individual decision making process to adapt with the technology. This was identified by the following comment:

It initially takes a bit of time to get used to the different hogues (scoring protectors) when you first try them out. The different systems work differently and score differently. And some of them are heavier than the others. So when I compete I have to change my technique to suit the equipment. It's a bit frustrating but now I am used to it, I can adapt quickly – where as when the different protectors first came in it was a whole new game, new tactics and a new way to play. The game continues to change because of the changes in the protectors and as such I have to change my game and the way I play it.

It was also noted that external factors, such as the accesses to train with the information technology, funds to acquire the information technology, etc, all play a major part. Unfortunately with the introduction of IT the gap between the wealthier and the poorer countries appears to have been widened, and the ability to be competitive at the elite level is now requiring considerably more resources due to the introduction of information technology.

Conclusion

This work shows that differing information technologies have been introduced into the sport with differing levels of success. In general this has greatly improved the playing environment but has resulted in the athlete now being required to shift both the management, including tactics, and decision making during a match to suit the technology being employed in a particular competition.

In most instances, information technology promotes a more attractive sport for both the spectators and the players due to the contest being determined without illegal play or tactics, but rather on the athletic ability and performance of the participants, with minimal human (referee) intervention in the scoring process.

This work also shows that there is still a certain further acceptance and confidence that must be achieved by the players and other participants of the sport. This can be achieved by the IT solution being sufficiently robust that it does not require athletes to adapt to varying versions or releases of the technology designed to achieve the same goal but function differently.

Information Technology should be used as an aid in the overall management of the game and the scoring of points, rather than a tool to administer the rules and regulations during the game. As with the ability of the athlete to vary and adapt the way in which he/she plays the game, so too should the management of the game remain ultimately a human function. There will always be the need to interpret and assess situations in a game based on the circumstances surrounding it, and this could not be done

purely using IT. If rule interpretation were to be administered using information technology without the application of the referee's knowledge, then the overall flow of the competition would more than likely cease, and even the most minor and possibly insignificant and unintentional infractions would be penalized. Appropriate IT solutions should be an avenue to have the points scored consistently, and an aid to the athlete to further enhance better decision making in order to improve the likelihood of scoring points on a platform even to both competitors.

Further Research

These results are drawn from only a limited sector of today's full time and elite Taekwondo athletes, and only from those to which the author had access. The findings of this study should be considered in that light. The study does lay the foundations for more detailed research to be constructed to further examine the potentiality of IT and its impacts on the decision making of athletes in both competition and their training protocols. Such further studies would extend to address the differing IT solutions being used, and the development of the game and game tactics to address the relevant technology being used in a specific competition. The results of such studies would enable sports administrators to be able to introduce IT solutions with a more complete understanding, and be able to tailor their introduction to focus on promoting better decision making, a fairer competition platform and subsequently improved player performance.

Acknowledgements

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