Women taekwondo competition structural feature indicator weight research based on AHP

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ABSTRACT

Modern sports competition is participating each party with its unique winning system makes mutual confrontation and constraints so as to obtain victory process, in Taekwondo competitive sport, every party has comprehensive, intensive, random and open features, in order to let athletes, coaches and organizer have a clear cognition on sport competition structural features, the paper takes women taekwondo event as an example, researches on sport competition structure based on analytic hierarchy process. In research, on the basis of passing consistency test, it solves each indicator weight and weighted value, which provides basis for taekwondo competition structural features selective analysis, finally it carries out t analysis of three layers' key factors, it gets importance degree ranking rationality obtained by weight values that provides research methods for mass athletes and coaches in sport competition structural exploring and analyzing process.   © 2014 Trade Science Inc. - INDIA

KEYWORDS

Women taekwondo;
Competition structure;
Analytic hierarchy process (AHP);
Indicator weight.

INTRODUCTION

Taekwondo is well received by the youth, the sport is constant developing in China, people pay more and more attention to the sport competitive features, in order to make people have a scientific understanding of taekwondo sport competition structure, the paper takes women taekwondo as an example to analyze the sport competition, in the hope of providing theoretical basis for sport competition structural analysis.

For sport competition structural researches, lots of people have made efforts, just by their efforts, let corresponding athletes and coaches scientific and calm face new rules and new opponents competitions, the research promotion provides more fertile ground for sport tech-nical innovation and new sport emergence, from which Liu Jian He(1997) made systematical research on sport competition value efficacy, competition and winning as well as competition organization management three basic problems, gives a detailed analysis of winning problems, which builds foundation for next research development[1]; Hu Yi-Hai etc.(2009)took same match confrontation group as carrier, adopted AHP analysis method defining competition structure four levels elements weight values, it got that constructed sport competition hierarchical structure was reliable, elements internal structures consistent and obvious feature conclusions[2]; Gao Ping etc.(2013) applied AHP analysis method to research on Chinese women taekwondo sport competition structural features, it got each layer

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element weight, and analyzed model analysis reliability on the premise of obtaining weight, which made statement for women taekwondo sport competition structural key element[3].

The paper on the basis of previous research, it analyzes women taekwondo sport competition structural features, in the hope of making contributions to mass athletes and coaches having a better seizing on each sport competition structure.

WOMEN TAEKWONDO COMPETITION STRUCTURE GENERAL STATEMENT AND HIERARCHICAL INDICATORS

Sport competition hierarchical structural feature

In 1995, China formally organized taekwondo, overall guiding thoughts for the event competition is striving to construct just, fair, and open domestic competition platform, reflecting and advocating "Training domestic against external" thought, in order to strengthen taekwondo competition appreciation and fairness, it is required to proceed according to certain regulations in competition process, in order to let athletes and organizer have a thorough understanding of competition, the paper makes research on women taekwondo sport competition structural features, in the hope of extracting competition result main influence factors, which provides basis for improving competition structure.

Taekwondo competition structure turns in hierarchical feature, the feature is concentrate reflection of sport competition constitutive each element features and structural features, if it can make scientific and reasonable analysis of sport competition hierarchical features, then it can comprehensive learn sport competition internal construction, besides, it can make clear sport competition hierarchical elements.

Sport competition is a kind of systematical project, the system includes competition design, before competition training, competition performance, competition guarantee and competition evaluation as well as several basic segments, according to competition preparation process and implementation process basic programs and composition elements, it can get as Figure 1 showed sport competition frame structure.

In Figure 1 1~15 are respectively represents: com-

petition process, competition preparation, competition referee, environment influence, present command, self-diagnostics, opponent diagnostics, environment analysis, competition design, state adjustment, competitive playing, competition evaluation, logistical support, medical and scientific support and competition rule.
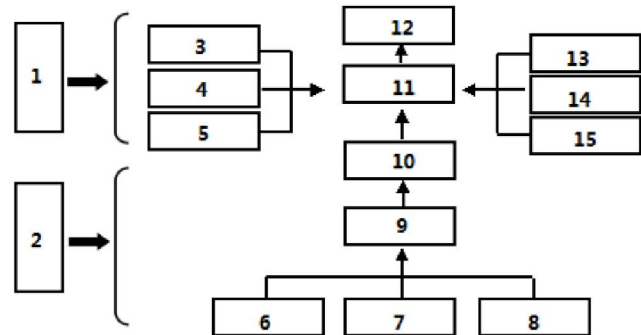

Figure 1 : Sport competition frame structure schematic diagram

Taekwondo competition hierarchical structural elements indicators

For women taekwondo competition process structural features, it summarizes as Figure 2 showed taekwondo competition hierarchical frame diagram, and makes definition description to each hierarchical indicator.
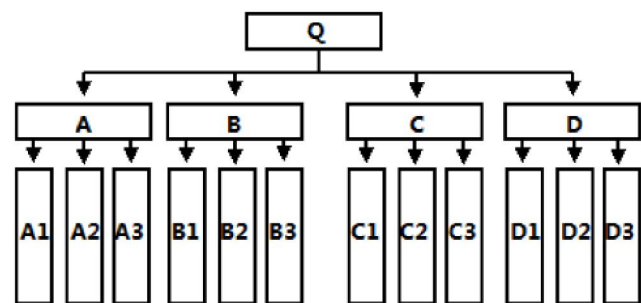

Figure 2 : Taekwondo competition structural frame schematic diagram

In Figure 2, Q represents taekwondo competition; A~B respectively represent before competition participating design, court factors influence, during competition actual fighting performance and after competition participating evaluation; A1~A3 respectively represent before competition state diagnose, participating design construction and before competition state adjustment; B1~B3 respectively represent competition environment influence, competition rule influence and competition support influence; C1~C3 respectively represents ath-

letes' competitive playing, coaches present command and referee competition judgment; D1~D3 respectively represent after competition recovery training, participating result evaluation and participating work summary.

Under A1~A3, B1~B3, C1~C3 and D1~D3 indicators, it respectively exists corresponding as A11, A12 and A13 three levels elements indicators, three levels elements indicators contents as TABLE 1 show.

TABLE 1 : Three levels elements indicators definition table

Symbol	Indicator description	Symbol	Indicator description	Symbol	Indicator description	Symbol	Indicator description
A11	Physical ability state diagnose	B11	Competition area weather effect	C11	Competition physical ability allocation	D11	Body recovery status
A12	Technique fighting state diagnose	B12	Audience atmosphere influence	C12	Competition technical and tactics response	D12	Psychology recovery status
A13	Mental state diagnose	B13	Court facility influence	C13	Competition psychological self-control	D13	Ability adjustment status
A21	Competition objective positioning	B21	Latest rule influence	C21	Court observation ability	D21	Competition performance evaluation
A22	Competition thought mobilization	B22	Competition methods influences	C22	Analysis and decision ability	D22	Performance indicator evaluation
A23	Participating plane appointment	B23	Competition schedule influence	C23	Language expressive ability	D23	Competition rank evaluation
A31	Physical ability state adjustment	B31	Scientific research service support	C31	Referee judgment way	D31	Training effect summary
A32	Technical and tactics state adjustment	B32	Medical service support	C32	Referee judgment scale	D32	Participating process summary
A33	Mental state adjustment	B33	Logistical service support	C33	Referee professional ethics	D33	Participating subject summary

WOMEN TAEKWONDO COMPETITION STRUCTURE HIERARCHICAL STRUCTURE MODEL

Analytic hierarchy process implementation steps

STEP1: Construct paired comparison judgment matrix

Every layer element relative to last layer one element single arrangement problem can be simplified into a series of paired elements judgment comparison, in the paper it introduces Saaty(1-9 ratio scale measurement table), and then writes into matrix form, as TABLE 2 shows Saaty(1-9 ratio scale measurement table), as TABLE 3 show judgment matrix form.

STEP2: Convert initialized judgment matrix into comprehensive judgment matrix.

At first, according to geometric mean calculation method calculate initialized judgment matrix each indicator paired comparison values, and convert them into final matrix, after that, for final matrix, according to formula(1) showed calculation method, it can get comprehensive judgment matrix:

$$\begin{cases} \mathbf{A(S)} = \left\lfloor \mathbf{a(S)}_{ij} \right\rfloor_{n \times n} \\ \mathbf{a}_{ij} = \mathbf{k}^* \sqrt[\mathbf{k}^*]{\prod_{S=1}^{\mathbf{k}^*} \mathbf{a(S)}_{ij}} \end{cases},$$

$$\mathbf{S} = 1, 2, \cdots, \mathbf{k}; \mathbf{i}, \mathbf{j} = 1, 2, \cdots, \mathbf{n} \tag{1}$$

STEP3: Calculate comprehensive judgment matrix maximum feature root corresponding feature vectors, and then normalize the vectors that are each indicator corresponding weights;

At first normalize every column of judgment matrix,

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TABLE 2 : Saaty (1-9 ratio scale measurement table)

Scale scores	Paired importance degree	Definition
1	Equal important	Indicates two factors have equal importance by comparing
3	Slight important	Indicates one factor is slightly more important than the other one by comparing two factors
5	Basic important	Indicates one factor is obviously more important than the other one by comparing two factors
7	Really important	Indicates one factor is intensely more important than the other one by comparing two factors
9	Absolute important	Indicates one factor is extremely more important than the other one by comparing two factors
2,4,6,8	in-between adjacent important degree	Two factors comparison importance degree is between above adjacent judgment

TABLE 3 : Judgment matrix form

A_k	B_1	B_2	$\cdots$	B_n
B_1	b_{11}	b_{12}	$\cdots$	b_{1n}
B_2	b_{21}	b_{22}	$\cdots$	b_{2n}
$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$
$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$
B_n	b_{n1}	b_{n2}	$\cdots$	b_{nn}

normalize is normalization processing, after that for judgment matrix after normalization, adding by column and let every column sum compose column vector, then normalize the column vector after adding sum of column, so the vector is maximum feature root corresponding feature vector, finally it gets maximum feature root.

STEP4: Comprehensive judgment matrix consistency test.

Consistency indicator CI computational method is as formula(2)show:

$$CI = \frac{\lambda_{\max} - n}{n - 1} \qquad (2)$$

When comprehensive judgment matrix has completely consistency, $CI = 0$, when CI gets bigger, it represents consistency gets poorer, in order to define satisfaction membership of CI, this paper introduces 1-9 order matrix average random consistency indicator RI, as TABLE 4 show.

When comprehensive judgment matrix order is above 2, judgment matrix consistency indicator CI and same order average random consistency indicator RI ratio is called judgment matrix random consistency proportion CR, when $CR < 0.10$, judgment matrix has satisfaction consistency, otherwise it needs to adjust

TABLE 4 : 1-9 order matrix average random consistency indicator

1	2	3	4	5	6	7	8	9
0.00	0.00	0.58	0.90	1.12	1.24	1.32	1.41	1.45

judgment matrix.

Taekwondo competition structure hierarchical analysis each indicator weight defining

Take C11, C12 and C13 as examples to establish hierarchical analysis judgment matrix, and run the judgment matrix, it solves three indicators corresponding weights, as TABLE 5 shows hierarchical analysis judgment matrix.

According to TABLE 5 judgment matrix, it can get as formula (3) showed three indicators weights:

$$\begin{bmatrix} 1 & 3/5 & 4/5 \\ 5/3 & 1 & 4/3 \\ 5/4 & 3/4 & 1 \end{bmatrix} \rightarrow \begin{Bmatrix} \alpha_{c11} \\ \alpha_{c12} \\ \alpha_{c13} \end{Bmatrix} = \begin{Bmatrix} 0.308 \\ 0.359 \\ 0.333 \end{Bmatrix} \qquad (3)$$

According to the method, it can get as TABLE 6 showed three levels indicator weight and weighting.

Similarly, it can get as TABLE 7 showed first level indicator and second level indicator corresponding weight and weighting.

Input TABLE 6 and TABLE 7 data into formula

TABLE 5 : Hierarchical analysis judgment matrix

Indicator	C11	C12	C13
C11	1	$\dfrac{3}{5}$	$\dfrac{3}{4}$
C12	$\dfrac{5}{3}$	1	$\dfrac{5}{4}$
C13	$\dfrac{4}{3}$	$\dfrac{4}{5}$	1

(2) to make consistency test, it gets consistency coefficient $CI = 0.004$, by searching TABLE 4 showed average consistency indicator $RI = 0.58$, it gets

$$CR = \frac{CI}{RI} = 0.0069 < 0.1$$ by calculation, so as TABLE

4 showed weight meets consistency.

Taekwondo competition structure each hierarchical indicator element arrangement

According to TABLE 6 and TABLE 7 second level indicator and third level indicator weighting as well as first level indicator weight, it can get corresponding indicators importance degree arrangement in the same layer, according to the principle that the bigger weight is the higher importance degree would be, it can get as TABLE 3 showed each indicator importance degree arrangement in the same layer.

WOMEN TAEKWONDO COMPETITION STRUCTURE HIERARCHICAL IMPORTANT INDICATORS ANALYSIS

First layer indicator analysis

In first layer, it totally has four indicators that are respectively A, B, C and D, corresponding importance degree arrangement is C>A>B>D, C corresponding indicator content is actual combat performance during competition, the segment is directly decides taekwondo athletes achieved performance, and the segment is completing by coaches and athletes subjectively, the two combination can common reflect athletes subjective playing degree.

A indicator corresponding content is before competition participating design, the segment is the result of coaches and athletes mutual cooperation, which can

TABLE 6 : Three levels indicators weight and weighting results table

Indicator	Weight	Weighting	Indicator	Weight	Weighting	Indicator	Weight	Weighting	Indicator	Weight	Weighting
A11	0.315	0.031	B11	0.341	0.024	C11	0.308	0.037	D11	0.311	0.015
A12	0.357	0.035	B12	0.375	0.026	C12	0.359	0.043	D12	0.328	0.016
A13	0.328	0.032	B13	0.284	0.020	C13	0.333	0.040	D13	0.361	0.018
A21	0.333	0.038	B21	0.369	0.028	C21	0.333	0.034	D21	0.269	0.011
A22	0.333	0.038	B22	0.343	0.026	C22	0.333	0.034	D22	0.359	0.015
A23	0.334	0.038	B23	0.288	0.022	C23	0.334	0.034	D23	0.372	0.016
A31	0.312	0.032	B31	0.302	0.021	C31	0.347	0.040	D31	0.333	0.014
A32	0.324	0.033	B32	0.347	0.024	C32	0.366	0.042	D32	0.333	0.014
A33	0.364	0.037	B33	0.351	0.025	C33	0.287	0.033	D33	0.334	0.014

TABLE 7 : First level indicator and second level indicator weight and weighting result table

Indicator	Weight	Weighting	Indicator	Weight	Weighting	Indicator	Weight	Weighting	Indicator	Weight
A1	0.313	0.098	B2	0.351	0.076	C3	0.342	0.116	A	0.312
A2	0.363	0.113	B3	0.326	0.070	D1	0.368	0.049	B	0.216
A3	0.324	0.101	C1	0.357	0.121	D2	0.310	0.042	C	0.338
B1	0.323	0.070	C2	0.301	0.102	D3	0.322	0.043	D	0.134

provide pre-arranged planning for formal competition and help athletes accidents provide pre-handling plan, and C indicator corresponding court factors can indirect affect athletes competitive level playing, though the indicator factor cannot promote to main factor, it will generate interference to athletes' competitiveness, if it can avoid these interference, and then it can ensure athletes have stable playing; D indicator corresponding

content is after competition organizing, though the segment has no big relations with competition winning, it will be great helpful for athletes' sports injury relieving and sports experiences extracting, if it can scientific and reasonable apply the segment, it can provide basis for athletes future development.

The second layer important indicator analysis

The second layer indicator, according to TABLE 8

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TABLE 8 : Taekwondo competition structure each layer indicator importance degree arrangement table

First level indicator	Arrangement	Second level indicator	Arrangement	Third level indicator	Arrangement
		A1	Sixth	A11	18
				A12	10
				A13	16
A	Second	A2	Third	A21	5
				A22	6
				A23	7
		A3	Fifth	A31	17
				A32	14
				A33	8
		B1	Eighth	B11	23
				B12	20
				B13	27
B	Third	B2	Seventh	B21	19
				B22	21
				B23	25
		B3	Ninth	B31	26
				B32	24
				B33	22
		C1	First	C11	9
				C12	1
				C13	3
C	First	C2	Fourth	C21	11
				C22	12
				C23	13
		C3	Second	C31	4
				C32	2
				C33	15
		D1	Tenth	D11	31
				D12	29
				D13	28
D	Fourth	D2	Twelfth	D21	36
				D22	32
				D23	30
		D3	Eleventh	D31	33
				D32	34
				D33	35

provided arrangement; it can get 12 indicators importance degree arrangement, as TABLE 9 shows.

From TABLE 9 arrangement, it is clear that coaches have very high focus on competition subject, because competition subject is participating performance main reflection way, taekwondo athletes levels playing degrees decide competition result evidence performance, therefore C1 indicator corresponding content athletes

competitive playing importance degree is the largest, in women taekwondo event, C3 corresponding content referee competition judgment is also the content correlated to competition performance, and A2 participating plan making, C2 coaches present command, A3 before competition state adjustment and A1 before competition state diagnose are guiding and promoting factors to athletes competitive level playing, from TABLE 9 importance degree arrangement, it is clear that athletes subjective factors has an obvious advantage by comparing with court and organization objective factors, that is to say, in competition process, athletes should establish self-centered consciousness, fully play themselves advantages, seize court initiative, try to do their work well, which is the key to achieve competition victory.

From TABLE 9 weighting comparison achieved indicators importance degree arrangement, after competition sorted factors have minimum influences on competition, though they have very little effects on the match, it is very important to athletes future development, analyze from the aspect, D1 corresponding after competition recovery training is most important, the segment makes objective contributions to athletes sports injury reduction, which is the crucial segment relative to athletes body capital, the next is participating work summary, the purpose of summary is to let athletes get experiences from competition and make good accumulation for future competition, D2 corresponding participating results evaluations effects are roughly the same as D3 participating work summary.

To sum up, women taekwondo athletes should pay attention to their own levels playing in competition structure, let subjective factors play more important role, which is the principle of "man proposes, and God disposes", besides athletes highlight formal game process,

meanwhile it should also focus on after game competition organizing segment, reduce sports injury to the minimum, which makes good preparation for long-term service, and can accumulate more plentiful experiences for athletes' future games.

The third layer important indicator analysis

TABLE 8 data indicates 36 pieces of three levels indicators importance degree arrangement status, due to indicators quantity is vast, in order to better carry out more deeply key analysis of the third layer indicators, the paper extracts top ten indicators factors according to weighting sizes arrangement, as TABLE 10 shows.

From TABLE 10, it is clear that the third layer indicator importance degree arrangement top ten factors all are before competition factors and during competition factors, from which before competition participating design segment entering into top ten indicators have A21, A22, A23, A33 and A12, their corresponding contents are respectively participating objective positioning, participating thought mobilization, participating plan assignment, mental state adjustment and technical and tactics state diagnose, A21 is primary task of taekwondo competition participating design, that is to say athletes should make a scientific position for themselves, and A22 is thought motivation for realizing A21, in order to make reasonable energizing and ideological emancipation for athletes, and can more effective let athletes arrive at top level during training, which provides ideological basis for supernormal performance.

Athletes and coaches mutual combination to scientific assignment on participating plans, it can let athletes adopt pre-assigning plans according to practice, the segment is also preparation segments relative important content, and athletes' themselves mental state ad-

TABLE 9 : The second layer indicator importance degree arrangement table

Indicator	C1	C3	A2	C2	A3	A1	B2	B1	B3	D1	D3	D2
Weighting	0.121	0.116	0.113	0.102	0.101	0.098	0.076	0.070	0.070	0.049	0.043	0.042
Order	1	2	3	4	5	6	7	8	9	10	11	12

TABLE 10 : The third layer indicator arrangement top ten key factors table

Indicator	C12	C32	C13	C31	A21	A22	A23	A33	C11	A12
Weighting	0.043	0.042	0.040	0.040	0.038	0.038	0.038	0.037	0.037	0.035
Order	1	2	3	4	5	6	7	8	9	10

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justment can let athletes make simultaneous fighting by applying psychology and techniques, arrives at psychological and physical combination effects. To technical and tactics state diagnose indicator, it needs athletes getting more ideal participating pre-arranged planning according to them and potential opponents fighting expectation, therefore the segment is the guarantee to participating plans designing.

From TABLE 10, it is clear that the third layer indicator important degree entering into top ten actual fighting factors during competition are C12, C32, C13, C31 and C11, above 5 indicators corresponding contents are competition technical and tactics response, referee judgment scale, competition mental self-control, referee judgment way and competition physical abilities allocation, due to new rules regulation, let competition time shorten, it requires athletes have competition control abilities, therefore C12 as response main reflecting abilities' indictor becomes competition performance main part, and C32 and C13 are also important variables under new rules designing, since electric gear judgment starting, taekwondo winning factors change from original "quick, complete, continuous, change, high" to "quick, accurate, skillful, attack, block", these rule contents changing also requires athletes have clearly seizing on them, only makes clear the ace point, they can achieve more scores and finally win the game, the premise of women taekwondo athletes present stable playing is athlete possessing stronger competition psychological self-control ability, which is also the reason that C31 is regarded as key factors, in present competitiveness, athletes if can look overall situation, ignore smaller gain and loss, well monitor overall situation ace, which require stronger psychological self-control ability. C11 is basis of C12, athletes only master physical abilities scientific allocation well and then can finally get victory, excellent athletes require possessing better physical ability and physical ability allocation ability, physical ability controlling merits degrees ask high for technical and tactics response meanwhile is also important reference object for technical and tactics response.

CONCLUSIONS

The paper analyzes sport competition structural hi-

erarchy, summarizes general sport competition structural features, and provides women taekwondo sport competition hierarchical structural frame form, in the hope of providing basis for taekwondo structure features exploring and analyzing; on the basis of defining taekwondo hierarchical structure, in the paper, by documents literature and expert interview method, it summarizes 36 pieces of three levels indicators corresponding to frame second level indicators, and defines competition hierarchical structure; the paper analyzes analytic hierarchy process application range, and discusses normal analytic hierarchy process realization steps, which provides theoretical basis for women taekwondo sport competition structural hierarchical analyzing; by applying analytic hierarchy processing, it gets three layers all indicators weights and weighting values, and utilizes paper provided consistency test model testing required weights reliability, it gets conclusion that weight passing consistency test; by each level indicator obtained weight and weighting, it gets indicator importance degree arrangement, which provides basis for subsequent taekwondo competition structural important factors analysis; it fully analyzes first level indicators and second levels indicators, analyzes each indicator importance degree arrangement rationality, and makes analysis of three levels indicators arrangement top ten indicators factors, it gets that athletes should highlight factors in the technical and tactics process, which provides scientific theoretical basis for sport competition structural features clarifying.

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