Risk Assessment of Hip-Hop Dance and Cheerleading Athlete’s Daily Training Based on FMEA

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Abstract—This paper carried out hip-hop and Cheerleading risk survey, classification and analysis for professional college athletes. Firstly, the risk factors and injuries in daily training are studied statistically based on questionnaire; then according to the former data, the potential risk factors are analyzed, which established the evaluation of categories, single factor and multivariate; finally, the daily training FMEA was establish, which combine ALARP principle with respect to potential risk factors, and suggestions were given for prevention and improvement. Our research has constructive significance to avoid or prevent risk in daily training and competition.

Keywords—risk identification; risk analysis; ALARP; FMEA

I. INTRODUCTION

During sport training and performance, the possibility of Physical Risk [1] [2] significantly increases, along with the fluctuation of risk factors and physical conditions of the athletes. One of the main factor can be recognized as the university students who participate in hip-hop dance and cheer leading have different background of dancing and physical condition, especially, hip-hop dance requires unique body balance which distinguishes it from other form of dancing. Individual cognitive can cause divergences in choreograph dance, not to mention individual physical coordination produces divergences during training, which can generate different risk [3]. Additionally, Individual's seemingly similar situation may perceive different risk perception characteristics. The complexity bring great changes in Hip-hop and cheerleading training.

SHI [5] analyzes the main risk factors among physical education organization, and summarizes major accidents in recent years. TIAN [6], FISCHHOFF [7], LINDELL [8] puts forward the psychological factors affection on student athletes, but there are few which focus on risk factors on daily training.

In our research, we focused on the risk assessment and analysis on Hip-hop and cheerleading training of college students. First, we categorized the risk factors, injuries of daily training based on the questionnaire we created specifically for our research, then according to the risk identification, category, unilabiate and multivariate evaluation were given; finally daily training Failure Mode and Effects Analysis (FMEA) was established with respect to as low as reasonably practicable (ALARP), and further prevention and improvement were given.

II. RISK ASSESSMENT PROCESS

Risk analysis can be categorized into two ways, narrow and broad, narrow risk analysis refers to quantitative analysis required to complete tasks at given cost, schedule, performance, which can be achieved through their PDF. The broad risk analysis is a way to identify and measure risks, development, selection and management of programs to address these risks needs. Which includes risk identification, risk assessment and risk management. We adopted the latter definition in our research. Risk analysis was divided into four areas, namely: problem definition; hazard analysis; risk assessment; risk management (Figure 1).

Figure 1. RISK ASSESSMENT PROCESS

A. Risk Perception

The train time, situations have lots of possibilities, which brought difficulties in our research. Furthermore, In view of the improvement of risks, adjusting the balance of risks for sports participants, and understanding the potential risks and safety can contribute measures objectively. FISCHHOFF [6] showed that there exists a balance between subjective and objective risk, when people being exposed to a certain risk event, their desires will generally not reduce this risk.
arbitrarily, they prefer to adjust their behavior to maintain this balance. That is, people would be willing to accept a certain level of risk.

The Problem identification data was from questionnaires which generated specifically suited for our research, which took the survey of 9 college students who participate in Hip-Hop and cheerleading, 116 valid surveys out of 200, the ratio of male vs. female and age distribution are showing in figure 2 & 3:

Prior experience of professional training in dance is necessary for understanding the assessment process of train risk, which can eliminate individual differences and also the subjective aspect of comprehensive cognitive differences. Following figures shows the professorial dancing training before Hip-Hop and Cheerleading.

FMEA (FMECA) is an inductive reasoning single point of failure analysis and a core task in reliability engineering, safety engineering and quality engineering method for risk assessment. In our analysis, the FMEA assigns a numerical value to each risk associated with a failure, using severity, occurrence and detection as metrics. Severity refers to the impact of the failure model. Occurrence refers to the likelihood that the failure will occur. Detection refers to rate the likelihood that the cause of failure will be detected before a failure can occur. Risk priority number (RPN) which can be used to analyze the process is then calculated by multiplying the severity, the occurrence and the detection of the risk. So the risky elements of the design can be measured by the rank of high value RPNs. Particularly, RPN can be used to sort the problems in analysis, but in actual FMEA, high-level of severity, high RPN values should be first taken into account for evaluating corrective measures prevention project. This order must be observed to reduce the risk levels: severe degree, occurred degree, detection degrees

Windchill Quality Solutions (formerly Relex) was chosen for risk assessment, which a fully integrated software suite considered the industry's most powerful reliability analysis toolkit. Harbin Engineering University has been an active part of WQS since 2010, which includes:
The FMEA model was chosen, which shares data of reliability prediction, and the data entry forms can be level-of-indenture or spreadsheet.

IV. FMEA APPLICATION AND RISK ASSESSMENT

A. FMEA Analysis

Generally, the FMEA includes 4 steps: (a) establishment of system information, (b) analysis, (c) improvement measures recommendation, (d) output of report. In this paper, the process of training was analyzed by means of FMEA on the basis of the principles and procedures. According to the assessment results on the questionnaire collected from some specialists and documents, the rationality and feasibility of the application of FMEA was finally confirmed. Table I through 3 indicate the RPN components for FMEA

<table>
<thead>
<tr>
<th>Scale</th>
<th>Description</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Catastrophic</td>
<td>Person die and structure scrapped</td>
</tr>
<tr>
<td>3</td>
<td>Critical</td>
<td>Person injured and structure damaged</td>
</tr>
<tr>
<td>2</td>
<td>Marginal</td>
<td>Time delay</td>
</tr>
<tr>
<td>1</td>
<td>Minor</td>
<td>Brief pause</td>
</tr>
</tbody>
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TABLE II. OCCURRENCE RATING SCALE FOR FMEA

<table>
<thead>
<tr>
<th>Scale</th>
<th>Description</th>
<th>Criteria</th>
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</thead>
<tbody>
<tr>
<td>9–10</td>
<td>Frequent</td>
<td>Probability of occurrence is greater than 0.1</td>
</tr>
<tr>
<td>7–8</td>
<td>Reasonably probable</td>
<td>Probability of occurrence is less than 0.1 but greater than 0.01</td>
</tr>
<tr>
<td>5–6</td>
<td>Occasional</td>
<td>Probability of occurrence is less than 0.01 but greater than 0.001</td>
</tr>
<tr>
<td>3–4</td>
<td>Remote</td>
<td>Probability of occurrence is less than 0.001 but greater than 0.0001</td>
</tr>
</tbody>
</table>

TABLE III. DETECTION RATING SCALE FOR FMEA

<table>
<thead>
<tr>
<th>Scale</th>
<th>Description</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>8–10</td>
<td>Almost impossible</td>
<td>No know monitoring methods available to detect the failure</td>
</tr>
<tr>
<td>6–7</td>
<td>Low</td>
<td>Low likelihood current monitoring methods will detect the failure</td>
</tr>
<tr>
<td>4–5</td>
<td>High</td>
<td>Good likelihood current monitoring methods will detect the failure</td>
</tr>
<tr>
<td>1–3</td>
<td>Almost certain</td>
<td>Current monitoring methods almost always will detect the failure</td>
</tr>
</tbody>
</table>

The FMEA process and sheet is showing below:
Based on the research, we can find that the coordinate action such as lifting etc. will cause great potential risk, certain standard rules should be established for this pattern, also along with presents of advisors, integrity of equipment. In mode three, particular attention should be paid for daily training, not only by raising individual quality but also by the guidance from their advisors, to keep the risk awareness.

Another serious problem in our questionnaire is that part of the athletes don’t take potential injuries and injuries seriously. There are random exist during daily training, 82.8% do not have medical specialists dealing with injuries, furthermore, when experiencing injuries such as sprain, only 28.4% express the willingness to take thoroughly physical examination, and for injury awareness survey, only 11.2% will take management are given for daily training.

From the perspective of risk analysis, in most accidents, human factors accounted for the major impact, if the athlete’s awareness of the risks raising, which will greatly improve. Based on the risk assessment and experience in training, we made the following recommendations

a) periodic diagnostic / counseling, starting with a clear goal, studies showed that: psychological factors in the training and competition was played, as well as to achieve the effect accounted for the major part of the team to help build a positive attitude towards the correct daily training, which will gradually help athletes to achieve a positive attitude. Respectively suggested training early, middle and late development of different strategies, if necessary, physiological consult can be introduced to the team, that is, one on one counseling to increase their self-confidence.

b) The team’s medical standards should be strengthened, accompanied with medical equipment and professional doctor. Periodic checks should be taken on the team, injury statistics also can bring further improvement on training methods, for instance, in our survey, elbow injuries appeared more than other injuries, and we can address this situation by recommending that players wear the appropriate protective gear according to the situations.

V. CONCLUSION

Based on the statistic survey of questionnaire, teaching and training experience, the risk assessment for Hip-Hop and cheerleading daily training was established, which categorized the risk factors and injuries. According to the risk identification, univariate and multivariate evaluation were given. FMEA and correlation analysis were given based on ALARP principle, which completed the following work:

- The risk identification, evaluation, assessment and management are given for daily training.
- Based on the questionnaire and survey, the FMEA of Hip-Hop and cheerleading were established in WQS (former Relex), and the RPN result and analysis were given.
- Combining with the experience and the result of risk assessment, certain analysis and suggestion were given. And the result shows that student athlete need further awareness on injury and treatment.

REFERENCES