

# **IMPROVING THE ODDS: REDESIGNING BLACKJACK TABLES FOR INJURY REDUCTION**

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## **ABSTRACT**

SKYCITY Entertainment Group Ltd sought assistance to redesign gaming tables due to a relatively high incidence of musculoskeletal disorders affecting table games dealers. Although this problem is accepted as being widespread in the gaming industry, a literature review indicated that little work on the functional aspects of table design has been undertaken, with anecdotal reports that most design changes were completed on a local or ad hoc basis - if at all.

An initial review of injury data and information from SKYCITY highlighted upper extremity and back discomfort for Blackjack dealers as a primary injury problem. Initial assessment included detailed dimensional analyses of the existing Blackjack table designs, interviews with dealing staff, task observation and anthropometric data review. A prototype Blackjack table was developed to address reach and work height issues, with the prototype refined via several project team site visits. A modified card dealing shoe prototype was also produced to address identified manual handling risk factors in card handling.

User trials with the prototype table and dealing shoe were completed. Trials encompassed interviews, the Nordic Musculoskeletal Questionnaire, anthropometric data collection, REBA analyses and task observation. Findings were used to determine a final Blackjack table and card shoe design in liaison with SKYCITY gaming and occupational health and safety staff and the equipment design/build firm. The resulting Blackjack table has some design features that appear to be a first within the gaming industry. The table and shoe was installed into a newly refurbished casino area with positive initial and ongoing feedback from gaming staff. Formal reassessment is planned.

## **INTRODUCTION**

The Occupational Health and Safety (OH&S) Manager and the Executive Manager - Gaming Projects of SKYCITY Entertainment Group Ltd, (Auckland, New Zealand) in March 2003 sought ergonomics expertise to address high levels of overuse injury reporting among table games dealers. In developing the project brief it was acknowledged that whilst

musculoskeletal disorders (MSD) have multiple causation, the project would focus on gaming table and related equipment design and function. The impact of other work system components such as work method, training, payment systems, breaks and task rotations were being addressed separately, and thus were not primary considerations for this project. The project was also driven by a relatively tight time frame for the commissioning of gaming tables for a refurbished gaming area.

Review of casino injury data for a five week period identified that 37% of injury reports were from dealers, with 26% of reports being MSD in nature. Of all reports, 20% were pertaining to upper extremity discomfort, 3% to back discomfort, and 3% to leg discomfort. 15% of all injury reports were attributed to dealing cards, and most reported injuries were to the right side of the body.

Literature review failed to identify any documented ergonomics work in the area of gaming table design, and anecdotal reports from individuals within the gaming industry indicated that if table design was addressed, it was done somewhat reactively and often with limited application of specialist expertise. The historical attitude within the industry was to either simply accept that 'that is how it is', or to suggest that injuries resulted from individual susceptibilities.

Blackjack is the game most frequently played in most casinos, and so involves potentially high musculoskeletal risk to dealers from task repetition, and the highest number of gaming staff. Blackjack table redesign was therefore identified as a priority. Redesign of Roulette, Money Wheel and Midi-Baccarat tables was completed similarly.

## **METHOD**

Key project personnel included the OH&S manager and OH&S Advisor, the Executive Manager Gaming Projects, the consulting physiotherapist who worked with rehabilitation of injured workers, the Table Games Operations Manager, and several Table Games Training staff. Initial information was gathered from OH&S records, informal interviews with these key personnel, and from observation of Blackjack games in the training room. Other personnel involved over the course of the project included purchasing department staff, and the design/build firm who fabricated the prototype tables.

Dimensional analysis of the Blackjack tables occurred (several different types were in use throughout the facility). The manual card dealing shoe was also reviewed. Analysis of the dealing task was completed via photographing and video-taping of dealers in simulated games in the training room. Discussion with these individuals identified areas of concern with the Blackjack table and dealing shoe designs.

Security reasons and customer privacy limited observation of active dealers in the casino environment. Access to surveillance camera footage of dealers working was similarly not permissible. The training room was therefore the only environment in which lengthy and detailed observation was possible, and where photographing and video recording of dealers at work was allowed.

Following the initial familiarisation visit key functional problems were identified. These included:

- Short and very tall workers had difficulty dealing comfortably
- Short workers struggled with both the height of the table (950 mm) and reach with cards to the dealer line (640 mm) and with chips to the boxes (770 mm to outside edge)
- Existing steps were of some benefit, but had to be bought in for use and were of fixed height (100 mm)
- The knee space under the table was limited, reducing standing position options, particularly the placing of one foot on a foot rest
- The stainless steel 'wear plates' on the leaning surfaces were uncomfortable
- When using the card dealing shoe the wrist extension position combined with the high frequency action (thousands of times per shift) appeared to be high risk.

Dimensional data and information on design problems were combined with anthropometric data, to formulate recommendations for a prototype Blackjack table suitable for formalised user trials. Given that dealing staff comprised a broad range of ethnicity including a reasonably high percentage of Asian and Indian workers, anthropometric data for these groups (Pheasant, 1996) was considered as well as NZ data (Slappendel & Wilson, 1992).

The prototype Blackjack table was fabricated, and two factory site visits by the project team were made to review its design and function prior to commencing user trials.

User trials proceeded in July 2003, with a table of finished height at 935 mm, 3 pull-out platforms (steps) of around 70 mm each, and a foot rest bar above the third step. The table layout, or 'felt' was altered for a 10-20 mm shorter reach to the 'dealer line'. The dealing shoe angle was altered from flat to angled by the insertion of a wedge under its base. Three different sized wedges at 10, 20 and 27 mm were trialed, in order to reduce the wrist extension required when dealing cards and when resting the hand on the shoe. An optional moulded hand rest was also trialed. A total of 14 dealers participated in the user trial, selected for anthropometric variation, handedness, gaming experience and gender. The user trials included a semi-structured interview, the Nordic Musculoskeletal Questionnaire (NMQ), anthropometric data collection, task observation, and later completion of REBA analyses from the video and photographic recordings.

## **USER TRIAL FINDINGS**

### ***Sample***

A total of 7 ethnic groups were represented in the user trial (Pacific Island, European, Maori, Chinese, Philipino, Indian and Taiwanese). 12 participants were right handed and 2 were left handed; there were even numbers of males and females; and dealing experience varied from 3 weeks to 7.5 years. 3 participants were both gaming supervisors and dealers, 1 was a gaming supervisor, 2 were 'casual' employees, and 8 were full time dealers.

### ***NMQ***

Key modified NMQ results were: 79% of participants reported shoulder discomfort occurring within the last 12 months (primarily right shoulder discomfort), 43% experienced neck discomfort, 43% lower back discomfort, and 36% wrist or hand discomfort. Lower

back discomfort and wrist or hand discomfort both impacted on ability to complete normal activities in 21% of participants. From the interviews, it appeared that few workers had made formal injury reports regarding the discomfort experienced, and they also had a poor understanding of discomfort management strategies.

### ***REBA Analyses***

Key findings from REBA analyses were:

- A female with less than 5<sup>th</sup> percentile stature measurements (standing eye, shoulder, elbow and knuckle heights), had *very high* risk levels (score 11) when reaching to place chips onto a player's 'box' at the centre of the table. Short stature resulted in trunk twisting and side flexion for adequate reach. Use of a 200 mm step reduced the risk level to *medium* (score 6).
- A male with greater than 95<sup>th</sup> percentile measurements for most stature measurements and his acromion-grip length, had a *medium* risk level (score 5) for the task of placing chips out at the centre of the table when standing on the floor.
- A female with approximately 50<sup>th</sup> percentile stature measurements, resting their wrist on the table surface near the standard manual shoe with fingers/hand resting on the shoe, had a *medium* risk level (score 5), that reduced to a *low* risk level (score 3) with use of the 20 mm angled raise in combination with a hand rest.

### ***Task Observations and Interview***

For the prototype Blackjack table trial, 57% of users preferred not to use any step (platform), 29% preferred using the first step, 7% used two steps, and 7% used three steps. A number of users (particularly experienced users) were reluctant to use the higher steps despite obvious biomechanical advantage, requiring additional coaching and explanation in order to do so. Some participants commented on the psychological impact/discomfort factor of being taller and at a different level with customers, feeling that this may require some adjustment. Some commented that the higher vantage point was a positive safety feature from a table visibility perspective. Most using the steps commented that they felt more relaxed and comfortable when dealing.

Participants felt that the step depth and width was adequate and felt safe, and there were no observations of workers being close to or stepping off the edge while dealing. Participants commented that the pull out steps had finger-groove handles that were difficult to grasp, and that some security/surveillance issues may result from the need to crouch down to pull them out (with the resultant momentary loss of visibility of the table surface). Some workers commented that the step options would allow them to select more comfortable footwear, rather than the platform and high heeled styles that had been selected for the height advantage afforded.

Workers were generally unaware of the benefit of postural variation achieved by standing with one foot on a foot rail, but found this to be comfortable. The prototype table foot rail was however too high, with inadequate knee space. Taller participants noted that a toe kick space was needed to make standing close to the table more comfortable. Some commented that they would prefer to stand at a surface lower than the flooring. Taller workers often stood with a stooped posture in an effort to work with the hands in an effective position.

Stainless steel ‘wear plates’ had been installed over the padded edge of the tables in the casino to prevent wear. The prototype Blackjack table did not have this, and was found to be more comfortable.

Participants quickly adjusted to the closer position of the dealing line, preferring the shorter reach distance and being unconcerned with the slightly smaller dealer work space created.

The gaming chip ‘float tray’ is kept covered and locked when the table is not in use. When the table is active the float tray cover is stored under the table. For the prototype table, the action of storing the lid on a shelf under the table was felt to be manageable, whilst still maintaining visibility of the table playing surface. Storage spaces for the card shoe and other minor items were reported to be adequate.

Shorter workers struggled to find a relaxed resting position on the card shoe when not actively dealing cards. All participants preferred to use the angled shoe, with 50% preferring a 20 mm high wedge. 43% preferred use of a hand-rest attached to the shoe. Use of the angled shoe made cards easier to grasp (as the thumb is under the card), as did a larger hole to through which to contact the cards, and use of a thinner material (Perspex).

### ***Anthropometric Data***

Data was collected to understand each participant’s anthropometry in relation to observed function and REBA analyses, and to gain a better understanding of the SKYCITY dealer population. Overall the user trial participants varied from the NZ population described in NZ Anthropometric Estimates (1992) with shorter Asian women and broader Pacific Islanders of both genders.

## **DESIGN ITERATION**

### ***Blackjack Table***

Following user trials, a number of recommendations were made: to add a toe kick space; reduce from three to two steps; provide additional knee space; alter the step heights to 80mm; make pulling the step out easier; ensure that the lean surface is well padded; narrow the depth of the chip float trays and move them as close as possible to the table edge; reduce reach distance by altering the design on the table felt for a closer dealer line; and use a template for correct fabric placement on the tables. Final table design was limited to an extent by customer comfort, engineering factors and cost, though endeavours were made to improve the fit of the table to a wide range of dealers. Members of the larger project design/management team had varied acceptance of table design changes, with some impact.

The user trial process also identified training factors to be addressed so that gaming staff could optimise the benefits of the redesigned user-adjustable Blackjack table. Some additional focus on the reporting of, and management response to MSD’s was also indicated.

After the trials and a series of prototypes and specific design enhancements, in December 2003 the new Blackjack tables were put into use. These tables were 960 mm high, and had two motorised steps (covered with non-slip rubber and with anti-fatigue padding) at 80 mm and 160 mm that were moved into place at the push of a button. The table had a closer

dealer line with the central point at 560 mm. The 80 mm shorter reach distance was created in part by flattening the arc on the dealer line and narrowing the float tray.

### ***Card Shoe***

Use of the angle-based card shoe allowed the dealer's hand/wrist to both operate and rest in a more neutral position. The shoe angle also allowed the cards to be dispensed with greater ease (getting the thumb under the card for easier grasp), though this was not evidenced in the REBA scoring method. Dealers quickly appreciated the improved dealing ease and resting comfort, with all participants preferring to use an angled shoe for Blackjack dealing. In December 2003 new angled shoes were in use at the new Blackjack tables.

### ***Informal Feedback***

No formal reassessment of this Blackjack table design has yet occurred, though commissioning of another casino area is underway and may allow this opportunity. The OH&S Manager reports that repeated informal observations and feedback has been almost uniformly positive. Specific feedback about the new Blackjack tables includes: the closer dealer line and reduced reach distances are good; the toe kick space needs to be deeper (from 50 to 100 mm); the automated steps are well-liked, but the top step is rarely used; and the table storage cupboard is too short for easy storage of the card shoe. These comments suggest that a formal review of table use and function will result in improved design for future tables, and this is planned.

## **CONCLUSION**

A Blackjack table with two automated steps and a shorter reach distance, and a modified card dealing shoe resulted from this redesign project. The effectiveness of both items should be formally reviewed with further design improvements likely. Work system factors other than design of the physical environment are relevant when considering MSD prevention for casino dealers.

### ***References***

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Slappendel, C. and Wilson, B. (1992). *Anthropometric Estimates for New Zealand Adults*. Ergonomics New Zealand 7:2. (pp 5-7). New Zealand Ergonomics Society.