ABSTRACT

The University of Virginia Athletic Department has experienced problems with actual student attendance at men’s home basketball games differing greatly from what was expected. There are also problems with admitting students into the general admission student section including maintaining the order of the student line prior to the game, and issues with students camping. The purpose of this project was threefold: to provide the Athletic Department with the tools necessary to more effectively predict student attendance; to suggest improvements for the existing procedures and policies for student fans; and to help with the campout process. This project produced a regression-based prediction model, a framework for the future implementation of a student attendance registration system, and a technology-based solution to support the maintenance of the order of students waiting to enter the arena. Student surveys were instrumental in assuring that the student preferences were considered in all phases of the work.

1 INTRODUCTION

The University of Virginia (UVa) men’s basketball team, a member of the Atlantic Coast Conference (ACC), has become increasingly popular in recent years both on a national level and within the UVa community. Much of this is attributable to what many consider a new era of UVa basketball that started when Head Coach Pete Gillen began coaching in the 1998-1999 season. Many policy changes were made by the UVa Athletic Department to accommodate the increased popularity and demand for attendance. Despite this, as the UVa basketball team entered its fifth season under Gillen, there were several significant problems related to student attendance at home basketball games.

Gillen believes that a larger crowd aids his team. He made a statement to the press after the home game against Duke University’s basketball team in February 2001: “It was an inferno out there. The students and our fans were unbelievable. They gave us a 10- or 12-point edge. It was a special win for our basketball team, our university and our community” (Doyel, 2001).

One key problem is that on many occasions, the student section of the arena has not been filled. This results in decreased home court advantage for the team, as well as the lost potential to sell the remaining tickets to the public. This problem is attributable to an inability to predict student attendance well ahead of game time. This lack of an accurate prediction makes it difficult for the Athletic Department to sell a sufficient number of tickets to the public for undersold, less desirable games. It also makes it difficult for students to know if the general admission seats were available.

Because the students can choose a seat after entering the arena, there is an incentive to be first in the waiting line. Significant problems have been experienced with student campouts, where students camp outside of University Hall in order to get the best possible seats. Many other prominent colleges and universities have had to deal with such camping problems – the most notable of which are Duke University, Florida State University, and Colorado University. At Colorado University, they have eliminated campouts altogether due to problems such as vandalism and rape (Bonnet, 2002). Unfortunately, the effects of an actual campout policy change can result in students feeling disconnected from the team (Meyer, 1996). When the attendance system at the University of North Carolina at Chapel Hill changed from a camping-based admittance policy to a random lottery, the students were upset and felt less engaged in the whole basketball process.

At UVa, the campouts have been safer and more organized. There have been no limits on the length of these campouts, and this often results in large student crowds outside of the arena. Side effects of the crowds include problems with alcohol and other safety issues, such as
fires. UVa officials also express their concern about the safety of the students and their living conditions while camping out, including sanitation and the lack of an academic atmosphere. The UVa Athletic Department believes that the campouts also cause a decrease in game attendance due to students seeing large crowds camping outside of the arena and believing that the student section will be full.

There were also problems in organizing the students in a fair and efficient way before they enter the arena. Hoocrew, a volunteer organization of student line monitors, formed in August 2001 to organize the student line and campouts outside of University Hall. Before Hoocrew, the line was a chaotic mass of students. During the 2001-2002 season, Hoocrew resolved many of these problems by developing and enforcing a set of policies that regulate campouts and the line to enter the arena. Despite their best efforts, Hoocrew members still experience several problems while trying to organize and maintain the line order.

This project attacked the student attendance problem on three fronts. One key result was the development of a regression-based predictive model of student attendance. The second key area included a framework for the future implementation of a student attendance registration system. The third key area was a technology-based solution to support the maintenance of the order of students waiting to enter the arena. Student surveys were instrumental in assuring that the student preferences were considered in all phases of the work.

2 STAKEHOLDER CONCERNS

To support all of the project thrusts, a thorough investigation of the attitudes of the key stakeholders was accomplished. The major concerns are expressed herein.

The UVa Athletic Department desires an effective solution that helps fill the basketball arena. With more students, there is an increased home court advantage for the team. However, if students do not attend, there must be support for greater ticket sales. Any developed solutions must be maintainable and cost-effective.

Several stakeholders are concerned about technological solutions. The UVa Registrar is concerned about any technology that uses student information. All access to systems using that information must be secure. The University’s Office of Information Technologies (OIT) supports the computing infrastructure for the University. Since developed applications to support student ticketing could be integrated with the University’s portal component (MyUVA), OIT could be impacted by the solution.

In addition, it is important to have the backing of the student body. The UVa Student Council and its subsidiary Athletic Affairs Committee are two important student groups. In particular, a controversy regarding the ticketing policies could adversely impact Student Council, so it is in their interest to collaborate on a system that the students will accept. The Athletic Affairs Committee of the UVa Student Council established Hoocrew, which monitors all activities during basketball campouts. This group is a stakeholder because Hoocrew will incorporate solutions dealing with line management.

The UVa Dean of Students is concerned about the rights and fair treatment of all students. Any new policies should support these principles.

Student fans are stakeholders because they will be involved in an increased attendance solution. The UVa Athletic Department wishes to draw these student fans to basketball games.

3 SURVEYING STUDENTS

A survey was developed to ensure that student preferences were considered in potential solutions to the identified problems. A set of issues were addressed by the survey: what factors affect students’ decisions to attend men’s basketball home games; the desired length and starting point of the registration period; how general admission seats should be allocated to the students; and the impact of camping in the new registration policy.

3.1 Results

Overall, 128 people were surveyed: 74 third-year systems engineering undergraduates and 54 campers at a men’s basketball home game.

3.1.1 Factors Affecting Attendance Decisions

To support the development of a predictive model of student attendance at men’s basketball games, the survey asked if any of the following factors influence students’ decisions to attend a game: UVa’s basketball team’s ranking, the opponent’s ranking, whether the opponent is a member of the ACC, whether classes are in session, whether it is the first game after break, the time of the game, whether there is inclement weather, the availability of parking, and whether the students could be assured admission. The test of proportions was used to analyze these nine questions. At 0.05 significance level, the survey results indicated that the following factors influence the students’ decision-making: UVa men’s basketball team’s ranking (N = 122; p < 0.001), their opponent’s ranking (N = 122; p < 0.002), their opponent’s membership in the Atlantic Coast Conference (N = 122; p < 0.001), whether or not classes at UVa are in session (N = 122; p = 0.001), the time of the game (N = 122; p = 0.012), and whether the students are assured admission (N = 122; p = 0.002). If data are available, the predictive model should investigate the incorporation of these variables.
3.1.2 Registration Period

Five survey questions addressed the desired length and start date for the registration system. One question asked what the minimum registration period should be (1–5 days). The median and the mode were each two days. Based on the type of the opponent, four questions asked the students how many days before a game they decide to attend (Table 1). Students decide to attend the games against ranked opponents much earlier than the unranked.

Table 1: When students decide to go to men’s basketball games (N = 88)

<table>
<thead>
<tr>
<th>Opponent Type</th>
<th>Median</th>
<th>Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ranked ACC opponent</td>
<td>2–4 days before</td>
<td>2–4 days before</td>
</tr>
<tr>
<td>Unranked ACC opponent</td>
<td>1 day before</td>
<td>On game day</td>
</tr>
<tr>
<td>Ranked non-ACC opponent</td>
<td>1 day before</td>
<td>2–4 days before</td>
</tr>
<tr>
<td>Unranked non-ACC opponent</td>
<td>On game day</td>
<td>On game day</td>
</tr>
</tbody>
</table>

3.1.3 Seat Allocation

A fair policy must be developed in the event that more students want to attend a game than there are seats available. Students were asked to rank the fairness of seven potential ordering methods on a scale of 1 to 5 where 1 is the least fair and 5 is the most fair (Table 2).

The survey showed that students preferred a method that gives priority based on attendance during the current academic year either with or without added priority to students who attended low-interest games. This result echoed the comments from the Athletic Department who prefer a method that prioritizes based on attendance at low-interest games.

For the registration system to be effective, it should ensure that students keep their commitments to attend games. Therefore, students were asked how fair (ranked 1–5, 5 being the fairest) it would be to punish students who break a registration commitment. Both the median and mode for this question were 4, thereby showing that students overall felt that it was acceptable to punish students who break a commitment to attend games. This is important as it allows the system to include an enforcement capability that will encourage students to attend a game.

It is possible that campers begin camping before the registration begins. Two questions gauged student opinions about this issue. First, students were presented with the following scenario and asked to choose which of two students should get into the game:

“Student A wishes to attend this game, but has not attended any other games during the season. This student could begin to camp out one week before the game. Student B wishes to attend the game, and has registered and attended every home men’s basketball game this season. Student B has been unable to camp out for any game this season including this game. If Student A gets into the game, Student B, who has attended every home game but not camped out, does not. If Student B gets into the game, Student A, who would like to camp out for 1 week, will not. Who should get in?”

Table 2: Fairness of seven potential ordering methods (N = 118)

<table>
<thead>
<tr>
<th>Method</th>
<th>Median</th>
<th>Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Random lottery</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Priority based on attendance at men’s basketball games during this academic year</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Priority based on attendance at men’s basketball games during this academic year with added priority to students who attended low-interest games</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Priority based on attendance at basketball games during all of a student’s academic years</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Priority based on attendance at basketball games during all of a student’s academic years with added priority to those students who attended low-interest games</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Priority based on academic year</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Priority based on attendance at other athletic events besides men’s basketball games</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

3.1.4 Impact of Camping in the New Registration Policy

Students supported Student A by a count of 49 to 17. Support for the camper was significantly higher than for the high-attendance fan (N = 66; p < 0.001). This indicated that students who camp out should gain priority over those students who do not camp out for a given game. To refine the results of the previous question, students were asked to choose between the following two potential purposes of camping (ordering only versus ordering and priority):

“Purpose 1: Camping should only affect the order you are allowed into the arena assuming your separate registration is accepted.
Purpose 2: Camping should affect the order you are allowed into the arena and prioritize you ahead of any students who are not camping regardless of your or their previous camping or commitment history.”

By a count of 79 to 43, students supported the second purpose: both order and priority (N = 122; p = 0.007). Therefore, students who camp out should be given priority over the students who register but do not camp out.

4 PREDICTIVE MODELING

The UVa Athletic Department uses predictions of student attendance at men’s basketball games to develop game-specific marketing strategies for the 2,738 general admission seats allocated for students. The Athletic Department currently bases its predictions on average attendance for similar games in the past, whether classes are in session, and any events that the Athletic Department feels may increase or decrease student attendance (A. Rader, personal communication, September 2002). This method does not incorporate any statistical methodology, and as a result, the predictions have oftentimes been inaccurate.

The goal of this effort, therefore, was to develop a better predictive model that could provide the Athletic Department with more accurate predictions of student attendance at UVa men’s home basketball games.

4.1 Previous Regression-based Studies of Sporting Event Attendance

Previous research in predicting attendance at sporting events has indicated the potential application of regression-based approaches. Results from previous studies are reported with adjusted $R^2$ value when available and an $R^2$ value otherwise. Using four seasons of basketball attendance data (1991-1992 through 1994-1995 seasons), Drea (1995) developed a five-predictor model to predict attendance at a National Collegiate Athletic Association (NCAA) Division II basketball program. In this model, the predictors were: location of the opponent, whether or not there was a prediction for snow, the average win/loss margin for the season, the predicted low temperature, and whether or not classes were in session. This model was successful, providing an adjusted $R^2$ value of 0.763 (Drea, 1995).

Drea (1991) conducted a similar study of attendance for the 1988 Springfield Cardinals minor league baseball team. Using 64 home games during the 1988 season, Drea identified three significant factors that influenced attendance: day of the week, whether or not a sales promotion was being conducted, and team performance (as measured by games out of first place). The model results were poor (an adjusted $R^2$ value of 0.340). These results were most likely attributable to the difference in attendance patterns between college basketball and minor league baseball.

A regression-based study to determine significant predictors of attendance at minor league baseball games was also conducted by Siegfried and Eisenberg (1980). This study did not focus on attendance prediction, but rather on the identification of important predictors. With data from 86 different baseball team seasons, the study found that seven predictors were significant: average ticket prices, number of home dates, percentage of the city’s population that was African American, how long the team has been in the city, excitement of the team (as measured by runs and homeruns per game), league (i.e., AAA, AA, or A), and the existence of sales promotions (Siegfried & Eisenberg, 1980).

An attendance prediction study was also conducted by Peel and Thomas (1988) for the English Football League during the 1981-1982 season. In this study, significant variables were the standings of the two teams, the physical number of miles between the home cities, the probability of a home win, and beginning/ending of the season effects that accounted for the first two weeks of the season and the last six weekends. For the four divisions within the English Football League (Divisions 1-4), the model resulted in $R^2$ values of 0.17, 0.31, 0.33, and 0.58 respectively. The varied success of these studies showed promise that a regression-based model might be appropriate for the problem.

4.2 Results of the Predictive Model

An interview with members of the UVa Athletic Department and the research literature suggested that several factors might be useful for attendance prediction:

- Time/day of the week of the game,
- UVa’s ranking (in the ESPN/USA Today Top 25 for the particular week),
- UVa’s win/loss streak,
- UVa’s win/loss margin for the previous game,
- The opponent’s ranking for the particular week,
- The opponent’s win/loss streak,
- The opponent’s win/loss margin for the previous game,
- The opponent’s popularity as defined by the Athletic Department (i.e., High-Interest Atlantic Coast Conference (ACC), Low-Interest ACC, High-Interest Out of Conference, Low-Interest Out of Conference),
- Whether other university events conflicted with the game,
- Whether classes were in session,
- Whether it is the game immediately following winter break,
• Predicted weather conditions on the day of the game, and
• Actual weather conditions on the day of the game.

These data were gathered from the 1998-1999 season through the 2001-2002 season (during Coach Pete Gillen’s tenure) because student attendance patterns prior to that point were not representative of current behavior.

The data were then coded and prepared for regression analysis. Because some of the variables were categorical, the list of factors yielded twenty predictor variables. Because of the small number of data points used to formulate this model (N = 58), it was determined that a six-predictor model would be the best model to predict attendance. Best subsets regression was then used to identify the best six-variable model (Table 3).

Table 3: Best Subsets Regression Results

<table>
<thead>
<tr>
<th>Number of Variables</th>
<th>Factors Included</th>
<th>R^2 value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Classes in session</td>
<td>0.411</td>
</tr>
<tr>
<td>2</td>
<td>Classes in session, Opponent ranked</td>
<td>0.622</td>
</tr>
<tr>
<td>3</td>
<td>Classes in session, Opponent ranked, UVa ranked</td>
<td>0.715</td>
</tr>
<tr>
<td>4</td>
<td>Classes in session, Opponent ranked, UVa ranked, Game after winter break</td>
<td>0.745</td>
</tr>
<tr>
<td>5</td>
<td>Classes in session, Opponent ranked, UVa ranked, Game after winter break, Predicted low</td>
<td>0.752</td>
</tr>
<tr>
<td>6</td>
<td>Classes in session, Opponent ranked, UVa ranked, Opponent popularity</td>
<td>0.816</td>
</tr>
</tbody>
</table>

This model explained a significant portion of the variance in attendance behavior (R^2 = 0.816, F_{0.05,6,51} = 37.8, p < 0.001). For this model, the regression coefficients appear in Table 4. The intercept represents the mean attendance when UVa and the opponent are not ranked, the opponent is a low interest ACC team, and classes are not in session. The remaining regression coefficients represent the expected change in student attendance for a one-unit change in each of the associated variables. The regression coefficients for UVa’s and the opponent’s rankings show that student attendance increases with success. For classes not in session, student attendance decreases by 744 students. For the three opponent popularity coefficients, student attendance increases when UVa plays a high interest opponent, and decreases when UVa plays a low interest out of conference opponent. From these results, it can be seen that maximum student attendance is obtained when classes are in session and the two teams are playing well. This model suggests that UVa student fans are fickle in their attendance patterns.

Table 4: Model Coefficients

<table>
<thead>
<tr>
<th></th>
<th>Coefficient</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>1096.42</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>UVa Ranked</td>
<td>398.02</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Opponent Ranked</td>
<td>474.20</td>
<td>0.003</td>
</tr>
<tr>
<td>Classes (If not in session)</td>
<td>-743.68</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>High Interest ACC Opponent</td>
<td>101.03</td>
<td>0.21</td>
</tr>
<tr>
<td>High Interest Out of Conference Opponent</td>
<td>54.08</td>
<td>0.37</td>
</tr>
<tr>
<td>Low Interest Out of Conference Opponent</td>
<td>-144.86</td>
<td>&lt; 0.001</td>
</tr>
</tbody>
</table>

Examination of the correlation coefficients showed no signs of multicollinearity in the formulated model. As expected, only the predicted and actual weather variables were highly correlated (but neither were found to be significant). Visual examination of the residuals also showed no signs of heteroscedasticity.

The formulated model was then validated with data from the 2002-2003 season. For the 2002-2003 season, the six-variable model had an average prediction error of 263 students, and a standard deviation of 269 students. This is an improvement over the Athletic Department’s existing prediction method, which for the 2002-2003 season had an average prediction error of 330 students, and a standard deviation of 324 students. A one-sided Mann-Whitney test revealed that the model errors were significantly smaller than those that were made by the Athletic Department (W = 160, p = 0.0283).

5 THE REGISTRATION SYSTEM

For this project, it was proposed that a web-based registration system would solve many of the stated problems by predicting attendance, and allowing more seats to be sold. The major recommendation is to have a two-step registration process. The first step is the registration phase, followed by the commitment phase. Both phases are required for assured admission into the arena.

5.1 The Registration Phase

The registration phase will require a student fan to access a web page. According to Timothy Sigmon of the Office of Advanced Technology, this access can be authenticated using the MyUVA portal infrastructure currently available at the University of Virginia. Once the authenticated student accesses the site, he or she may have the option to register for one upcoming men’s home basketball game if the reg-
The registration period is in effect. The registration period will occur a few days before each game.

This registration step can be likened to placing the student’s name in a hat. Throughout the registration period, any bona fide student has the opportunity to place his/her name into this hat. Once the registration period ends, no more names may be placed into the hat.

5.2 The Commitment Phase

The commitment phase is the action that completes an assured admission. Given that a student properly registers (i.e., places name into the hat) and is selected, he or she will receive an electronic confirmation that a general admission seat has been reserved. Any student not selected for commitment will also receive an electronic confirmation.

It is recommended that the system incorporate a capability for student fans to withdraw/retract a commitment. Such a retraction would make a seat available. In the event that students registered but did not receive commitments, these students should be allowed to request newly available seats.

Two reasons for this method of registering are to maintain flexibility on behalf of the student fan to complete the registration process at a time convenient to him/her and to reduce the likelihood of high user traffic at one particular time.

5.3 The Registration Period

In deciding the placement and duration of the registration period, a number of factors were considered. First, the Athletic Department Ticket Manager preferred to have two business days during which to sell any seats not demanded by students. As the business office is only open Monday through Friday, this means that ticket sales for a Monday game would have to start on a Friday (Table 5). Second, he wishes to have a uniform policy regardless of opponent (R. Mathias, personal communication, 2002). However, it is important to consider the interests of this system’s main users, the students.

5.3.1 Duration

Based on the survey results, Section 3.1.2, the registration period should last 48 hours.

5.3.2 Time before Game

Despite the survey results in Section 3.1.2 that indicate the need for fewer than two days to make a decision to attend, the Athletic Department should adopt the policy in Table 5. A consistent policy not only helps the Athletic Department, but also the public wanting to buy tickets.

5.4 Penalizing Broken Commitments

Another aspect of the registration system encourages accountability from committed student fans by penalizing those students who do not attend a game to which they have committed. The survey results show that students support the concept of penalizing those who break commitments. In the event that more students register than there are student seats, the concept of penalty implies that some students can be prioritized over others. To do so, a priority scheme must be developed to select which student fans will be granted commitments and which ones will not.

Table 5: Recommended registration periods as a function of game day

<table>
<thead>
<tr>
<th>Game Day</th>
<th>Registration Period (Start – End)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sunday</td>
<td>12 a.m. Tues. ⇒ 12 a.m. Thurs. Can sell Thursday / Friday</td>
</tr>
<tr>
<td>Monday</td>
<td>12 a.m. Wed. ⇒ 12 a.m. Fri. Can sell Friday / Monday</td>
</tr>
<tr>
<td>Tuesday</td>
<td>12 a.m. Sat. ⇒ 12 a.m. Mon. Can sell Monday / Tuesday</td>
</tr>
<tr>
<td>Wednesday</td>
<td>12 a.m. Sun. ⇒ 12 a.m. Tues. Can sell Tuesday / Wednesday</td>
</tr>
<tr>
<td>Thursday</td>
<td>12 a.m. Mon. ⇒ 12 a.m. Wed. Can sell Wednesday / Thursday</td>
</tr>
<tr>
<td>Friday</td>
<td>12 a.m. Tues. ⇒ 12 a.m. Thurs. Can sell Thursday / Friday</td>
</tr>
<tr>
<td>Saturday</td>
<td>12 a.m. Tues. ⇒ 12 a.m. Thurs. Can sell Thursday / Friday</td>
</tr>
</tbody>
</table>

5.5 Prioritizing Commitments

In order to penalize an individual student fan, a point structure can be established. A student who has attended the game to which he or she committed can be credited with a number of points specifically chosen by the Athletic Department for that particular game. Similarly, a student who does not attend the game to which he or she has committed can have a certain number of points. The system can maintain a current-season point total for each student at the University and apply this total when deciding who receives commitments.

The survey indicated that a two-part tiebreaker would be viewed as fair by the students (Section 3.1.3). First, priority would be given to students who have attended the most games with extra weight given to low-interest games. Second, in the event there are still ties, students will be selected randomly since that is an unbiased, definitive solution.
6 DESIGNING TOOLS FOR HOOCREW

For the past two years, a team of 12 students called Hoocrew has maintained the line order for fans to enter University Hall for a men’s basketball game (“Official,” 2001). Hoocrew registers groups when they first enter the campout line. Hoocrew conducts roll calls, a procedure to ensure that groups maintained a presence in the line at all times. Each group had to have at least one member present during every roll call. Hoocrew either sends groups to the back of the line or removes them completely if they miss two or more roll calls. Hoocrew assigns wristbands to help maintain the line order. A couple of hours before the game, they use the wristbands to line up student fans to enter University Hall in the correct order based on their arrival time to the campout.

This system works, but it requires that the members of Hoocrew put in extensive amounts of time and effort. With these best efforts, fans still leave the line for extended periods and manage to get out of order. Hoocrew needs a better line management system (the set of policies, practices, procedures, and tools used to keep people in the waiting line in order based on the idea of “first come, first served” while also ensuring safety and fairness). Those responsibilities include checking students’ IDs when they register for a campout and when they pickup wristbands. Hoocrew ensures that wristbands are distributed to the correct people. They also execute roll calls randomly throughout a campout to ensure that groups keep at least one member in line at all times.

This part of the project attempted to meet this need by conducting a systems analysis of the line management system. The systems analysis included establishing the goals of the system, exploring alternative solutions and choosing an appropriate one to pursue, and iteration, experimentation and implementation (Gibson, 2000).

Through this process, some key tasks were identified that a Hoocrew line management tool should support. First, the tool should store information about groups and group members including their names, wristband numbers, e-mail addresses, and successful roll calls. The tool should store other information on roll calls including the groups that failed to attend and when the roll call was initiated and completed. Hoocrew should be allowed to assign wristband numbers automatically to all of the groups while still allowing new groups to enter the campout. The tool should provide reporting and search functions so that users can maintain information about group members. The tool should be protected by a secure login. Finally, the tool should support the use of student ID cards as a quick means for entering and verifying student information.

A member of Hoocrew had built a rudimentary tool during the previous academic year. As an interim solution as well as a proof of concept for the eventual solution, software was designed, implemented, and tested to handle many of the Hoocrew line information management functions. The development of this software, called HooList 2.0, accomplished two objectives: provided Hoocrew with a working database management tool to help with the campout and the waiting line, and identified many of the software requirements that the final system would have. Unfortunately, this interim solution was still missing capabilities such as automatically identifying students based on reading their student IDs. Toward the development of the final solution, more comprehensive systems were investigated, including a PDA system using barcode scanners, an automatic kiosk, and a system using magnetic card readers. The magnetic card reader system (MCRS) had the most potential for success when considering cost, feasibility, implementation and quality factors. The card reader connects to a laptop computer as an input device. When the reader interprets the information, it immediately translates that information into numbers. Users swipe cards embedded with information in two-track magnetic strips through the reader, and the computer enters the embedded information into a database. The convenient features of this system include the ability to use student ID cards and student information that UVa already maintains. It also means that HooList 2.0 can be revised and used as the database management software.

One significant concern with this system is in the security of student information. A UVa student’s ID card comes embedded with the student’s ID number and other irrelevant information. To get the other information necessary for Hoocrew’s operations, the computer has to transmit the information from the student ID card over the network to the UVa Business Operations database. Then, the database cross-references the student ID number to find all of the other pertinent information that Hoocrew needs. The database then transmits that information back to the Hoocrew computer (G. Conley, personal communication, February 12, 2003). Unfortunately, in most cases the student ID number is also the student’s social security number. UVa is not prepared to give Hoocrew access to students’ ID numbers, so a secure method to get around this issue must be developed (C. Stanley, personal communication, March 10, 2003).

One possible way to address the security issue involves having HooList 2.0 process student ID numbers in such a way that the user never sees the numbers and such that the computer running HooList never stores the numbers. After extracting a student’s ID number, the card reader should pass that information around “behind-the-scenes” through secondary programs to the UVa Business Operations database. That database can then return the necessary information to the HooList database. To the user, it appears that the student information entered the HooList database as a direct result of swiping the student’s ID card. Effort in this direction is promising.
With these preliminary results, problems still exist relating to crowd control and line formation in the last two hours before fans enter the arena. Further work is required to complete the MCRS subsystem and to investigate problems that arise near the time fans enter the arena before a basketball game.

7 DISCUSSION OF FUTURE WORK

Stakeholder opinions indicate that both general and specific changes need to be made to the student admission process for men’s basketball games. Developing an integrated version of the Hoocrew software/hardware for better campout line maintenance and developing the online registration system to guarantee student seating show promise in addressing these issues.

Integrating the Hoocrew hardware with the line management software should provide Hoocrew the capability to ‘commit’ campers to attending basketball games automatically. This integration would also improve the campout process for student fans because campers could quickly receive wristbands or check-in for roll calls using their student IDs. By aiding the Hoocrew, one can reinforce their effectiveness in managing, at times, over 2,500 students.

Developing the online registration system would help the Athletic Department financially as well as improving their ability to fill all of the seats in the general admission section of the arena. Filling the seats is a concern given the future construction a new basketball arena with larger capacity.

Before final decisions are made, an expanded survey should be administered. This will prove invaluable in support of the modified student admission process. It is important to have the support of the students and University administrators as the students are the primary users and are the reason for the University’s existence.

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REFERENCES


AUTHOR BIOGRAPHIES

MARTIN RADZIO is a fourth year student in the Department of Systems and Information Engineering at the University of Virginia. Martin plans to work at Lockheed Martin as a Systems Engineer. He is a founding member of Hoocrew. Martin has sailed to Bermuda and is the reigning champion at his golf club.

THOMAS “TAD” WALLS is a fourth year student in Department of Systems and Information Engineering at the University of Virginia. Starting in July, Tad will work at Northrop Grumman Newport News as a Systems Engineer.

GREGORY JOINER is a fourth year student in the Department of Systems and Information Engineering at the University of Virginia. Gregory has camped out for
virtually every ACC game in the past two years and has even been made fun of by Stewart Scott on ESPN’s Sportscenter.

**BRANDON ROGERS** is a fourth year student in the Department of Systems and Information Engineering at the University of Virginia. Brandon likes the color blue and Phish’s music. He will be getting married in the spring of 2004.

**ELLEN J. BASS** is an Assistant Professor in the Department of Systems and Information Engineering at the University of Virginia. Her research interests include cognitive systems engineering, dynamic decision making, human-automation interaction, intelligent decision support systems, and intelligent learning environments.