COMPUTERIZED FOOTBALL SCOUTING ANALYSIS

by

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ABSTRACT

The purpose of this investigation was to design a system of processing football scouting data that would yield the information desired on opponents by the football coaching staff at Montana State University in a minimum amount of time.

A scouting form was developed based on the data deemed necessary to gain all the pertinent information on football opponents. This collected data was then programmed for a system of computer analysis. The process was designed to categorize the scouting data into usable, meaningful information which would assist in game-plan preparation.

Conclusions arrived at as a result of this investigation were, first, that a considerable amount of time was saved with this computerized football analysis. The information was analyzed much faster than if done manually. The coaching staff, therefore, had more time in which to prepare the team for the game and the team had time to get acquainted with the opponent's scouting information. Secondly, there were many more combinations of information made available through this process. Another asset derived from this system of scouting analysis was that it became a valuable tool for self-evaluation of our own team.

Recommendations made as a result of this study were that the computer analysis be expanded to include additional information about the opponent in the following areas: (1) ball-carrier breakdown with respect to frequency of carry at various points of attack; (2) the kicking game, to include the punt, punt return, kickoff, kickoff return, quick-kick, and field goal; (3) the opponent's personnel, to include individual statistics, strengths and weaknesses; (4) opponent's defensive alignments and variations, strengths and weaknesses.

CHAPTER I

NATURE OF THE PROBLEM

The trend toward two platoon football along with the fact that coaching staffs, for the most part, are larger and better trained have added significance to the important task of scouting (gathering information on opponents). As a result of these two factors there is more specialization, and players, who, in the past, split their practice and playing time between offense and defense, are now devoting all their efforts to one of these areas. This, of course, has led to the concentration of coaching efforts in either the offensive or defensive phases of football. These advances in the game of football have brought about more skilled performances along with the potential of more diversified offensive attacks or defensive plans. Therefore, it is more important than ever to have accurate scouting information on your opponents in order to be able to prepare a game plan that will assist your team in winning the game. With the added potential of football teams, it becomes necessary to have a well-organized method of collecting and analyzing scouting data. This investigation dealt with football scouting, but it was felt that in order for the reader to better understand the study, a brief explanation of factors affecting

game preparation, scouting methods and types of information collected was necessary. A brief discussion of these items will appear in the following paragraphs.

I. FACTORS AFFECTING GAME PREPARATION

The success of football teams across the country is often measured by win-loss records at the end of the season. This record is usually affected by such factors as caliber of players, injury to key personnel, skill of coaching staffs and weather conditions. The caliber of players will depend on the success of the recruiting program and the ability of the coaching staff to develop available personnel. Both of these factors are of primary importance if coaches are to mold a team that will be competitive.

Football is a contact sport and, as a result, there are injuries that may affect the overall performance of individuals and teams. When injury occurs to key personnel coaches must make adjustments which may necessitate moving players from one position to another. If there are adequate personnel in each position, on the other hand, little affect may be felt by injuries.

The skill displayed by a team with respect to blocking, tackling, and running is a reflection on the ability of the coaching staff. The well conditioned, well prepared football team will appear mentally and physically alert, and display

an ability to adjust to situations as they arise during a game. Players will commit fewer mental and physical errors, which will make them hard to beat. The team that makes the fewest mistakes in a game will normally have the best chance of winning.

Weather conditions bother some teams more than others. The heavy, slow team may be affected less by sloppy weather conditions than one that is smaller and quicker. A football team that passes predominantly may be affected more by wind conditions than one that relies heavily on the running game. The kicking game of both teams may be affected by wind conditions, depending on the direction of the wind at the time of the kick.

The tactical preparation of a football team, which of course involves all of the above factors, is dependent upon a carefully planned scouting schedule. The scouting plan is determined as soon as the next season's schedule is finalized. All opponent's schedules are placed on a calendar-type chart with the time and place of all games. It is common practice to scout each team twice before playing them. Two factors are usually considered in determining when to scout a team. First, it is most beneficial to see a team play someone of comparable strength to yourself who employs similar offensive and defensive systems. Through this

method it would be easier to predict what the opponent may do against you. Secondly, if at all possible, it is of distinct advantage to see them in their most recent games. This should enable you to be aware of their latest innovations. The next step is to negotiate with each opponent with respect to a possible film exchange. Whether or not this negotiation is successful, it may further be desired to attempt to borrow film from some of their other opponents. Through this procedure, it is possible to have information on nearly all of your opponent's games.

II. METHODS OF SCOUTING

Most athletic conferences allow teams to scout each other on two different occasions during the season. This involves attending the game and recording all necessary data required on the scouting form that will be discussed in Chapter II. This gives the coaching staff a first-hand look at the opponents. A drawback of this method is that if something is missed during the progress of the game it is impossible to go back and pick it up.

The second method commonly used in scouting opponents is through the film exchange. Opponents may agree to exchange one, two or more films in lieu of or in addition to scouting. This practice has become increasingly popular in recent years with most teams having access to motion-picture films of all

their games. This method of gathering data is extremely accurate, as each play may be re-run as many times as necessary to extract the needed data. The camera lens may not, however, pick up all action in the game and it is usually necessary to combine this technique with the previously mentioned scouting method. Film exchange may also be made with common opponents. Through the use of these methods information is gathered on all opponents with respect to their kicking game, defense and offense.

Each opposing coach will have his own philosophy of the game of football. He may place equal stress and importance on all aspects of the game, or, on the other hand, may emphasize one or two of the areas over the others. In addition to this, each coach may place special emphasis on elements within a particular area which in turn may be revealed in specific tendencies that develop in his style or philosophy of coaching. The personnel available, with varying degrees of talent and ability, will also influence the type of football team a particular coach may produce. Individual teams often display a particular pattern or style of play unique to them. As mentioned above, this uniqueness may follow the general philosophy of the coach and be further individualized by the talents and abilities of the players. In order for a football team to be prepared to play an opponent, then, the coaching staff should know as much as

possible about opposing coaches' philosophies and past associations, strengths and weaknesses of opposing team personnel, and as much information as possible about the team's kicking game, defense, and offense. This can be accomplished only by a continual study of the opponent through the medium of scouting.

Scouting is not something that is done only the week prior to the game, but is a continuous study of all opponents on the schedule. During the off-season, film studies may be conducted of past games with an opponent, and also by borrowing film from common opponents. Valuable information from this process may be filed for future reference. The scout is able to prepare himself before his scouting assignment the following season by acquainting himself with returning personnel of the opponent and familiarizing himself with the opponent's offense, defense, and kicking game. In this manner he will be able to do a better job of scouting and gathering information deemed necessary by his coaching staff to best prepare their team for the game. In the final analysis, the scouting report should answer the following questions: How can we win? Where can we gain? What must we stop?

III. TYPES OF INFORMATION GATHERED

The game of football may be divided into three general categories with respect to scouting an opponent: the kicking game which includes the kickoff, kickoff return, onside kick, punt, punt return, quick kick, field goal, and point after touchdown; the offensive game, including the running and passing attack; and the defensive package, which contains the defense against both the run and pass. These three elements of scouting information are discussed in more detail in the paragraphs which follow.

The coaching staff at Montana State University has spent many hours evaluating motion picture film of football games throughout the United States in a continuous effort to stay abreast of modern day football. At the same time, analysis of the importance of the kicking game and the effect a good or poor kicking game has on the outcome of the many contests played throughout the country on all different levels of competition has been conducted. With very rare exception, it may be stated that the kicking game is often the difference between success and failure of the majority of football teams.

Field position football, as it is commonly referred to in coaching circles, is largely a product of the kicking game. That is, the type of offense and defense a team uses varies

with respect to the location of the ball on the field of play. A team is less likely to have a wide open passing and running attack when it has the ball deep in its own territory near the goal line. The type of offense run will normally be of a more conservative nature. Plays which require intricate ball handling are less likely as a possible resultant fumble would place them in a defensive hole. Likewise, the probability of a pass is much less, as a pass interception could result in either a score or field position advantage. As a result of the location of the kicked ball in this position on the field, the defensive team has the advantage of keeping the offense in the hole. On the other hand, the offensive team as it moves the ball over the field toward the goal line of the defensive team, begins to gain the advantage over the defense in that a more wide open offense may be employed.

The offensive portion of the kicking game often includes those phases dealing with the return of the ball following a kick, the kickoff return, and the punt return. It is easy for the fan and the average coach to visualize the value of this phase of the kicking game and to justify the practice time used to develop skills and abilities in this area. The point after touchdown and field goal fall in the same category, with points being awarded for successful attempts.

It is necessary to analyze the so called defensive aspects of the kicking game a little more thoroughly to visualize their importance. When this is done, one may even have a tendency to place all phases of the kicking game in the offensive catagory.

If the kickoff lands deep in the end zone, the receiving team will very likely elect to down the ball and put it into play on the twenty yard line. This may occur if the kickoff team is alert and hustles down in coverage of the kick. If the ball is kicked high and falls between the five yard line and the goal line, the receiving team has little choice but to return the ball to the best of their ability. Here, the alert coverage has the opportunity of making the tackle inside the opponent's twenty-yard line. In each of these instances the offensive team is limited, to a certain extent, as to the type of offense it may employ. A fumble, as a result of a complicated running play, or the pass interception, could place that team in poor field position. If the offensive team is limited in its attack, the defensive team has a better chance of forcing the offense into a punting situation deep in their own territory, thereby gaining possession of the ball somewhere near mid-field. With even a slight gain on the punt return, the ball would be put in play on about the thirty-five yard line. With the gain of a first down on a series of downs, the ball would be resting

near the forty-five yard line of the offensive team. If forced to punt in this situation, and assuming the same as above, with a good punt, and excellent coverage by the kicking team, the ball should be inside the opponent's twenty-yard line, maintaining advantageous field position. Therefore, the punt and its coverage takes on importance in the struggle for field position.

The onside kick is also a valuable weapon to be included in a team's arsenal. It is a means by which the ball may be recovered by the kicking team, provided it goes at least ten yards, if it is imperative that they try to get the ball for another score. It may also be used as a surprise element if the opponent is careless in the coverage of the kick. There is a certain risk involved in using this weapon, because, if the ball is not recovered by the kicking team, field position advantage will go to the receiving team.

The quick kick (a method of kicking the ball from a normal running formation) and its coverage may likewise be of extreme importance in situations similar to those mentioned about the punting game. The quick kick may be even more effective as the return by the defensive team is less likely due to the surprise element. More advantageous field position is often the result of a properly executed quick kick.

Once a team loses field position advantage, it is

extremely difficult to regain the advantage during the entire half of a game, unless a break (fumble recovery, pass interception or blocked kick) should occur in the team's favor. If a break, such as a fumble or pass interception should occur against the team with poor field position, the result often leads to a score for the opponent.

If a team is forced to sustain the ball and drive a distance of seventy yards or more, they have a five percent chance of scoring. On the other hand, if a team has fifty-yards or less to drive for a score, there is a fifty-five percent chance of scoring. Here again, statistics are based on a continual survey by the coaching staff and are comparable to figures quoted by other coaches around the country in coaching clinics. Field conditions, weather, fumbles, interceptions, penalties, along with physical and mental errors, have an important effect on the chances of a team maintaining the ball for a long period of time and over an extended distance. The kicking game plays an all important role in obtaining and maintaining field position advantage.

Through many hours of discussion and film analysis of various team's kicking strategies, the coaching staff at Montana State University has developed a list of data to be accumulated in the scouting process. A considerable amount of specific data about the kicking game is required to be able

to answer the following questions completely:

> How long does the punter take in kicking the ball?
> Does the center snap the ball well consistently with someone aligned on him defensively?
> Do they protect the punter well?
> How far is the punter from the line of scrimmage?
> Is it possible for us to block a punt?
> How far and how high does the punter kick the ball?
> Will we be able to set up a punt return against their coverage--if so, how and where?
> Do they have a good kickoff man?
> Where does he kick to consistently?
> Do they cover the kickoff well?
> Can we return the kickoff--if so, how and where?
> Do they onside kick--if so, how?
> Do they use the quick kick--if so, how?
> Do they have a good point after touchdown and field goal kicker?
> Do they have any trick plays from these formations?
> Do they have excellent speed on the kickoff and punt return?
> Do they return the ball well--if so, how?
> Are there any points that may give us the winning edge in the kicking game--if so, what are they?

The defensive aspect of a football game is also of great importance. It has often been said by coaches that it is impossible to lose if you don't allow a team to score. The strategy for maintenance of field position falls largely upon the defensive plan. If a team has field position advantage, the defense is able to keep the pressure on the offense and thereby increase chances of forcing a mistake with a fumble, pass interception, or a large loss. On the other hand, the offense is able to keep pressure on the defense if it has field position advantage. Incidentally, there are as many ways to score while on defense as there are on offense. An offense may score with a kickoff return, a run,

a pass or a field goal, while a defensive team may score by tackling the ball carrier in the end zone for a safety, by blocking a punt, by a pass interception, or by a punt return. Of equal importance is the fact that the defense can turn the ball over to the offense in advantageous field position where they have the greatest chance of scoring. In order to do this, a defense must be sound against the opponent's running game and prepared to prevent a score with the pass. The defense must be prepared to take away the opponent's favorite plays and place strength against strength to neutralize the offensive attack. If the defensive team is to accomplish all these ends, it must know the following about the opponent's offense:

> What are their favorite formations, plays and ball carriers?
> Are they a passing or a running team?
> Do they show preference to a specific formation, play or player when they are in a must situation?
> Do they have favorite formations with down and distance or field location?
> Do they have trick formations or plays?
> Do they have a good passing game, short, long?
> Who are their favorite receivers?
> What is their favorite throwing action? Is it dropback, sprint out, bootleg or play pass?
> What must we do to keep them from scoring?

The offensive aspect of football has been traditionally the most popular with the fan and average coach. This is due to the spectacular potential involved with the long run and the long pass. Offense is of equal importance to the other phases of the game as it must, for the most part, take the ball

where its defensive team has regained it and attempt to score. There are different philosophies of offensive football. Some coaches like to throw the ball and employ the passing game as their basic type of attack. Others prefer to use the running game and will pass only when absolutely necessary. There are varying degrees of use of the passing and running games and of course, many coaches feel that one should compliment the other and be of equal importance in their offensive attack. It is of great importance, whatever the philosophy may be, for the offense to be prepared to attack the opponent's defense. It is common practice to find the opponent's defensive weaknesses and apply the offensive strengths in that particular area. A game plan may also call for devising ways and means of attacking the opponent's strengths with the idea that, if the ball can be moved against the defensive strengths, it will effect the morale and confidence of the defense. A team needs to know, then, several specific items of information about an opponent's defense:

What are the basic defensive alignments?
Do they use multiple defensive alignments or adjust from one basic defense?
What are the strengths and weaknesses in their defense against the run?
What type of pass defense do they use?
What are their strengths and weaknesses against the pass?
How can we move the ball against them?
Will we have to make adjustments in our basic offense to beat them?

Do they use different defenses on different down and distance situations and field positions?
What is their goal line and short yardage defense?
Are there any points that may give us the winning edge on offense?

The scouting process then, is very important to the success of a football team. As one might see from the amount of information desired, ultimate organization and skill is required to compile the data and transform it into usable, meaningful material upon which to base a game plan. This is further complicated by the amount of time necessary to compile and breakdown the collected data. The Montana State staff spent from six to twelve hours compiling and breaking down the necessary information on a scouting report. With anywhere from one to five reports available on a given opponent, the final information to be used in the game plan formation is difficult to prepare before mid-week of the game. There is also a limited amount of information that may be made available due to the time factor. The information is of little value if the team is not completely familiar with it and able to put it into practice for the game.

IV. STATEMENT OF THE PROBLEM

The purpose of this investigation was to devise a scouting form on which all pertinent data could be recorded about each play, during the scouting process, data from which

questions, previously discussed, could be answered about the opponent's defense, offense, and kicking game. A second purpose was to design an information processing system whereby all the desired information, and combinations thereof, may be made available to the coaching staff in a minimum amount of time, thus, allowing the coaches to better prepare the team for a coming opponent.

The development of a scouting form and design of an information processing system are described in detail in the chapter which follows.

CHAPTER II

DESIGN OF AN INFORMATION PROCESSING SYSTEM

This portion of the investigation deals with the collection of scouting data, development of a process of computer analysis, and the use of the processed data by coaches. The collection of data will include the methods commonly used in gathering information along with a description of items contained on a scouting form. The process of computer analysis will include a description of the key punching operation, programming instructions for the computer, and a discussion of the categories of information resulting from the process.

I. COLLECTION OF SCOUTING INFORMATION

There are three ways, introduced in Chapter I, in which scouting information is generally collected. The most common method used is where the head coach delegates one or two of his assistants to a scouting assignment, which would require that they travel to the game and collect the data desired. Another method used, is film exchange with the opponent, and the third method, is film exchange with common opponents.

In the first method, one or two scouts may observe a team. If one scout does the observation by himself, he will

have to record all preliminary data about each play, be alert to pick up backfield action, and describe line blocking on each of the plays. The preliminary data would include the quarter of the game, down and distance, position on the field and team formation as it breaks from the huddle and approaches the line of scrimmage. On the snap of the ball he would note backfield action and blocking pattern used, pass routes of receivers if the play was a pass, and any special information about team personnel. A football scout working alone then, must be well organized and extremely well disciplined to see all the action during a particular play.

If two scouts were utilized, the responsibility would be distributed between them. For example, one could talk while the other recorded, or one could watch backfield action as the other observed the blocking by the line. Needless to say, a better job of scouting would often result when two competent scouts worked a game together.

A tape recorder may be of value to scouts in recording a maximum amount of information. The process of compiling the data from the tape is usually more time consuming, but the additional information may be well worth the additional time.

The two other methods of gathering data involve film exchange. One, conducted during the off-season, involves

study of films borrowed from common opponents while the other made during the season, involves exchange with opponents in lieu of or in addition to regular scouting practices. Information is recorded from films in the same manner as in the scouting procedure described in preceding paragraphs. Usually, however, more coaches are available during the process of "film scouting" so that information gathering may be divided into segments. One coach may do nothing but record the data as it is given, another may watch the backfield play, the line blocking may be divided between two coaches, and still another could observe personnel or pass patterns and indicate the yards gained on each play. This film scouting method is quite complete, as plays may be re-run as many times as necessary. Thorough study may also be made of individual personnel strengths and weaknesses.

The data collected during these scouting procedures are recorded on a scouting form specially designed by the coaching staff. There are numerous ways in which a scouting form may be organized. The logical order in which the items appear should coincide with the order in which they are collected in the scouting process. Figure 1, shown on the following page, depicts the type of form that was devised for conducting this investigation. The reader should note that items appearing on any given school's scouting form depend

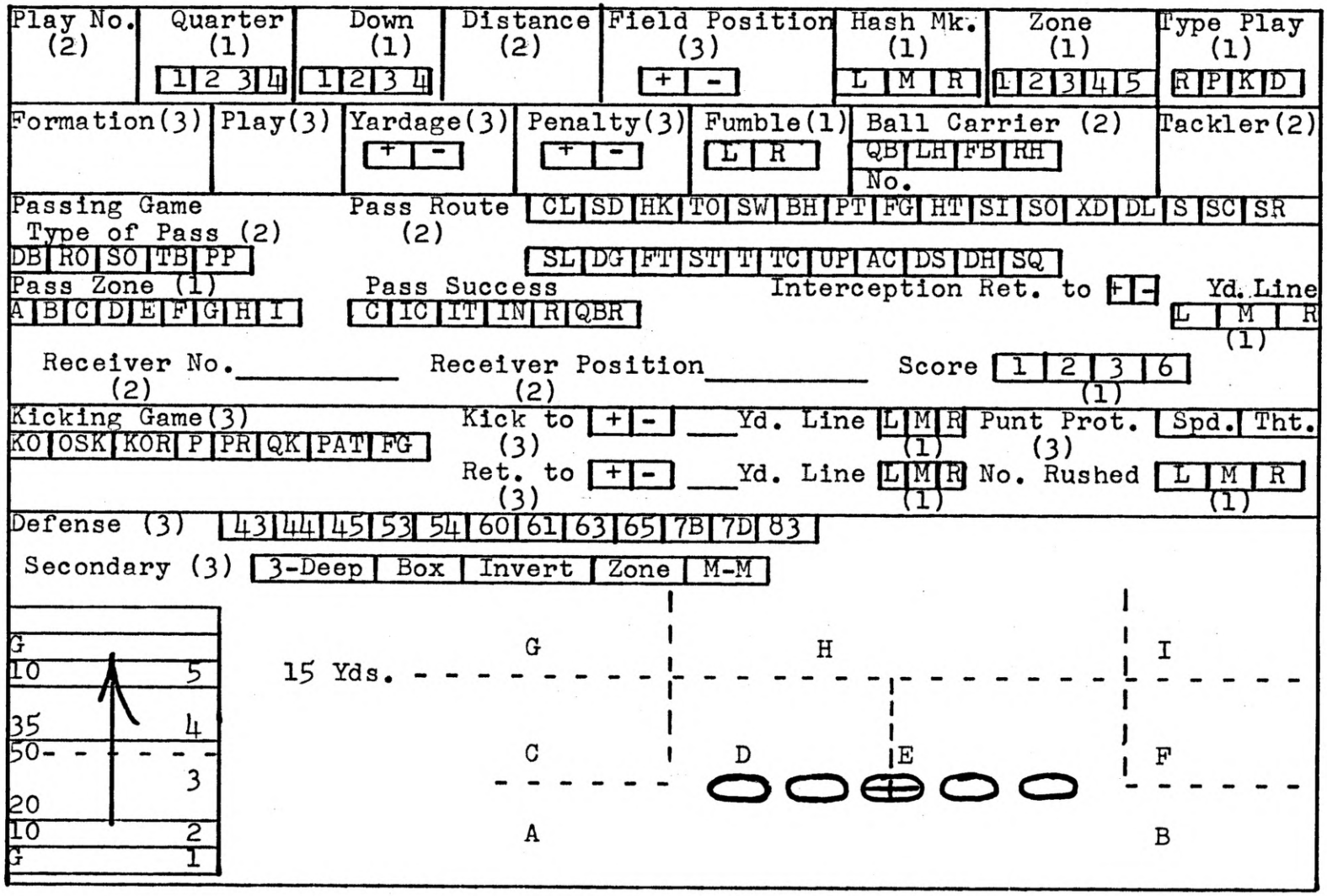


Figure 1. Scouting Form Used For Collection Of Data.

upon the type of data or combinations thereof desired by the coaching staff.

One sheet of this form is completed on each play run by the team being scouted. An explanation of items appearing on the form will perhaps be beneficial to the reader and will help to detail the problems encountered in this investigation. Each term or item, reading from left to right and beginning in the upper lefthand corner of the form, will be explained briefly in the discussion that follows.

1. Play number - This indicates the chronological order of plays throughout the game (a play by play).
2. Quarter - This refers to the quarter of the game in which the plays were run.
3. Down - The number of the down on which the play was run is recorded in this area.
4. Distance - This indicates the yardage required to gain a first down.
5. Field position - This is the north-south location of the ball on the football field. The yard line where the ball is put into play. The minus (-) indicates that the ball was on the team's own side of the fifty yard line. The plus (+) indicates that the ball was on the opponent's side of the fifty yard line.
6. Hash Mark - The east-west location of the ball on the field. The (L) indicates that the ball was on or within three yards of the left hash mark. The (R) indicates that the ball was on or within three yards of the right hash mark. The (M) indicates that the ball was located between the previously mentioned points.
7. Zone - Refers to the north-south location of the ball on the field. Zone one being from the team's goal line coming out to the ten; zone two, from the ten to the twenty; zone three, from the twenty across the fifty to the opponent's thirty-five; zone four, from the thirty-five going in to the ten; and zone five, from the ten to the opponent's goal line.

8. Type of Play - Running plays are indicated by an (R), passing plays by a (P), kicking game by a (K), and defensive plays by a (D).
9. Formation - The tactical deployment used by the team on offense (T, single wing, wing right, wing left, pro right, pro left, etc.).
10. Play - The offensive play run. This is indicated by coded information coinciding with the scouting team's nomenclature and terminology.
11. Yardage - The plus (+) or minus (-) yardage gained on the play.
12. Penalty - This item is used if applicable, to indicate a plus (+) or minus (-) penalty assessed on the play.
13. Fumble - This is used only where applicable, with (L) denoting a fumble lost, and (R) a fumble recovered.
14. Ball Carrier - The team member who carries the ball: quarterback (QB), left halfback (LH), fullback (FB), or right halfback (RH). The player's number is also indicated.
15. Tackler - The position and number of the opponent that makes the tackle.
16. Passing Game - This section is used only if the type of play indicated in Item 8 was a pass (P).
    A. If the particular play was a pass the notations are drop back (DB), roll out (RO), sprint out (SO), throw back (TB), and play pass (PP).
    B. Pass Route - Notations are coded into two letter abbreviations which indicate the individual route executed by the pass receiver. The abbreviations and their significance are: (CL) curl, (SD) sideline, (HK) hook, (TO) takeoff, (SW) switch, (BH) bench, (PT) post, (FG) flag, (HT) hitch, (SI) slant in, (SO) slant out, (SC) X-deep, (DL) delay, (S) slip, (SC) slip close, (SR) screen right, (SL) screen left, (DG) drag, (FT) flat, (ST) streak, (T) trailer, (TC) trailer-curl, (AC) across, (DS) diagonal-safety, (DH) diagonal-halfback, (SQ) squirrel, and (WH) wheel.
    C. Pass Zone - This refers to the lettered areas located in the lower right portion of the page. The zones are: A, B, C, D, E, F, G, H, and I.
    D. Pass Success - The symbols and their significance are: (C) complete, (IC) incomplete, (IT) interception, (IN) interference, (R) rushed, and (QBR) quarterback ran the ball.
    E. Receiver Number - This is the jersey number of receiver.

F. Receiver Position - This refers to the position played by the receiver, that is, (LE) left end, (RE) right end, (LH) left halfback, (RH) right halfback, and (FB) fullback.

G. Interception return to - This item is recorded only if the pass was intercepted. The notation here is where the ball was returned after the interception: to the plus (+) or minus (-) yard line; left (L), middle (M), or right (R).

17. Score - If a score was made on the particular play it is indicated here: (1) for a point after touchdown; (2) for a safety or a point after touchdown run or pass; (3) for a field goal; and (6) for a touchdown.

18. Kicking Game - This section is used only if the type of play indicated in Item 8 was a kick (K).
   A. The symbols are: (KO) kickoff, (OSK) onside kick, (KOR) kickoff return, (P) punt, (PR) punt return, (QK) quick kick, (PAT) point after touchdown and (FG) field goal.
   B. Kick to - The ball was kicked to the plus (+) or minus (-) yard line, left (L), middle (M), or right (R).
   C. Return to - The ball was returned to the plus (+) or minus (-) yard line, left (L), middle (M), or right (R).
   D. Punt Protection - If the play was a punt (P), the type of protection is indicated by (SPD) spread, or (THT tight.
   E. Number Rushed - If the play was a punt return (PR), the number that rushed the punter is indicated with left (L), middle (M), or right (R) checked if the rush emphasis was placed in a particular area.

19. Defense - This section is used if the type of play indicated in Item 8 was defense (D).
   A. The general defensive categories listed are those commonly used in football. The first digit of each set indicates the number of men deployed on the line of scrimmage, with the number of linebackers specified by the second digit. Those most commonly observed are: 4-3, 4-4, 4-5, 5-3, 5-4, 6-2, 6-3, 6-5, 7B, 7D, and 8-3.
   B. Secondary - This indicates the type of deployment used by the defensive backfield, 3-deep, box, invert, zone, or (M-M) man to man.

20. The diagram located in the bottom right portion of the form, which includes the dotted indication of the passing zones, is used to record special comments relative to the particular play appearing on this

sheet. Comments pertinent to special blocking schemes or unusual play action are recorded in this area.

21. The north-south field diagram in the lower left portion of the form is simply a reference for the scout in referring to the north-south zone breakdown of the football field. The team being scouted is always considered as the one going north on the diagram.

It may appear as though the number of items included on the form would be impossible for one scout to collect during a game. A scout will rarely miss any of the items on the form, however, if he is well organized and experienced. For example, items 1 through 7 may be recorded between plays while the team is in the huddle. Item 9 is recorded as the team approaches the line of scrimmage and items 10, 11, 14 and 15 are recorded immediately following the snap of the ball.

Sections of the form devised for recording information about the passing game, kicking game and defensive information are, of course, used only if applicable to a particular play.

Gathering of information is a major problem in scouting, but categorization, analysis, and synthesis of this data is equally difficult. A process was developed in this study for reducing the complexity of the latter problem. This process, involving computer analysis, is explained in the section which follows.

II. PROCESS OF COMPUTER ANALYSIS

Having collected and recorded the scouting data as described in the previous sections of this study, it was, then, necessary to design a process which would rapidly analyze information for use by the coaching staff. This process included the key punching operation, programming instructions for the computer, and the readout.

IBM cards were key punched on the basis of data gathered from the individual scouting sheets, described in the previous section. The key punch operation was quite simple, as the machine was similar to a typewriter and anyone with typing experience could perform this function. A standard eighty-column data card, shown in Appendix A, was punched for each play.

Each item of information found on the individual scouting sheet was assigned a specific number of columns on the card. Figure 2, on the following page, shows information punched in each of the card columns. Column eighty on the card was used for indicating special comments, which would then be explained in more detail on the next card. This comment may have described the blocking used or anything else peculiar to the play in question. The key punch operator recorded the information on the scouting sheet in the assigned columns on the data card. Also, an automatic skip card was

Card Columns	Entries
1-2	Play number
3	Quarter
4	Down
5-6	Distance
7-9	Field position
10	Hash mark
11	Zone
12	Type of play
13-15	Formation
16-18	Play
19-21	Yardage
22-24	Penalty
25	Fumble
26-27	Ball carrier position
28-29	Ball carrier number
30-31	Tackler number
32-33	Type of pass
34-35	Pass route
36	Passing zone
37-39	Pass success
40-42	Intercepted-ret to yd line
43	Intercepted-ret to hash mk
44-45	Receiver number
46-47	Receiver position
48	Score
49-51	Type of kick
52-54	Kick to yd line
55	Kick to hash mk
56-58	Returned to yd line
59	Returned to hash mk
60-62	Punt protection
63-64	Number rushed punter
65	Side of line rushed
66-68	Defense
69-71	Secondary
72-79	Skip
80	Comment indicator

Figure 2. Computer Data Processing Card Column Assignments

inserted into the key punch machine so that, if there were no data to punch in specific columns, the skip key was punched, and the carriage moved to the next item.

"Object decks", which included instruction cards for the computer, were prepared. These decks of cards included all instructions to the computer to categorize scouting information. These instructions may, incidently, also be stored in the computer on a disc tape. If this were done, it would only be necessary to insert one master card with the data cards from the scouting report, which would include the project number, and the tape would be selected from storage. The report, scouting data, was then analyzed and printed in the order desired to produce meaningful and useful information to the coaching staff and, in turn, to the football team. This printed material will be referred to as the "readout" in the remainder of this report.

This scouting analysis was programmed to readout data under the following headings and in the order discussed in the following paragraphs: A "numerical, chronological listing" of each play, plays by "down and distance", plays by "formation and hash mark", "mileage chart", "box score", "passing game", "passing game statistics", and "kicking game". Terms used above were described in a previous section in this chapter.

The first heading that appeared on the readout con-

sisted of a "numerical, chronological listing" of each play. For example, play number one included all data punched on the first card, and play number seventy-five included all information recorded on card number seventy-five. From this readout it was possible to follow games, play by play, and often diagnose specific types or patterns of play which were helpful in planning game strategy. A complete analysis was also made of all comments that were read out as a result of the comment cards. These were usually comments about personnel or blocking schemes.

Secondly, plays were listed by "formations". Each individual formation used was shown with all plays that were run from that particular formation. The sub-headings under the formations were: the play number, down and distance, hash mark, zone, type of play, play, yardage, ball carrier, ball carrier number, fumble and score. The basic information found in this breakdown was favorite plays from certain formations. It was also often possible to obtain valuable information when exploring the data contained under each sub-heading. The following tendencies often appeared:

1. Play number - It may have indicated that this particular formation was used during a specific time in the game, ie. early, late or in a particular period.
2. Down and distance - The formation may have appeared predominently in a certain down and distance situation.
3. Hash Mark - This combination appears later in the readout as a major category of information desired.

4. Zone - Did this formation show up in a specific zone?
5. Type of Play - Does this indicate a tendency to run or pass from this formation?
6. Play - This is the basic information desired from this category.
7. Ball Carrier and Ball Carrier Number - Did they show a tendency to use a certain ball carrier while in this formation?

It must be noted here that this general analysis of formations may or may not have revealed any tendencies. At the very least, it indicated the opponent's strengths and weaknesses in different formations. These served, then, as guidelines for deploying our own team's strengths and weaknesses against those formations. An example of a play that appeared in a readout under a formation is illustrated in Figure 3 below, with an explanation of items and symbols contained under each column.

Play No.	Down Dist.	Zone	Type Play	Play	Yard-age	Ball Carr.	Fumble	Score
16	1-9	5	R	42	+9	FB33		6

Figure 3. Example of a "formation" readout appearing on this scouting analysis. Play number sixteen was run from this formation on 1st down with nine yards to go. It was located in zone five, (which is from the plus ten yard line to the goal line), and the type of play was a run (R). The play was a 42, which is the fullback hitting over his right guard, for a gain of nine yards. The ball carrier was the fullback, number 33. There was no fumble on the play and a touchdown was scored. All other plays in the game run from this formation were listed in the same manner in that, if there was information punched on the data card in each of the sub-heading columns, it would appear in this readout.

When all the opponent's formations had been analyzed,

the next heading was that of plays run from "hash mark" locations. Here, again, all plays were listed that were run from the three laterial (east-west) locations on the field: the left hash mark, right hash mark and center of the field. The sub-headings were play number, down and distance, zone, type of play, formation, play, yardage, ball carrier, ball carrier number, fumble and score. Information generated from this readout of plays run from hash mark locations suggested, for example, tendencies for a team to run to the short or wide side of the field. If such tendencies appeared, this information was used advantageously in formulating the defensive game plan. An example of a play that appeared in a readout under one of these hash mark locations is illustrated in Figure 4 below, with an explanation of items and symbols contained under each column.

Play No.	Down Dist.	Zone	Type Play	Form.	Play	Yard-age	Fum.	Score
4	2-8	3	R	PR2	58	-3	L	0

Figure 4. Example of a "hash mark" readout appearing in this scouting analysis. In the above readout, the play was number four, in a 2nd and eight situation. The zone was three, which is from the minus twenty to the plus thirty-five yard line, and the type of play was a run from formation PR2, which is the left end split wide left, the flanker split wide right, and the two remaining backs behind the offensive tackles. The play was a 58 (left halfback sweep right), for a loss of three yards. The ball carrier was the left halfback (LH21), number twenty-one. There was a fumble on the play which was lost (L), and there was no score. Here again, all plays were listed under their appropriate columns with respect to the hash mark location.

Following the readout of all plays from the left, right, and middle hash marks (east to west), the plays were listed with respect to their appearance in the north-south "zones" (end zone to end zone). The sub-headings appearing under each of the five zones were play number, down and distance, hash mark, type of play, formation, play, yardage, ball carrier position, ball carrier number, fumble, score. The basic items desired from this readout were plays run in each of the north-south zones and preferences displayed with respect to "zone and type of play" or "zone and formation". An example of a play printed out under one of the zone headings is illustrated in Figure 5 below, with an explanation of items and symbols contained under each column.

Play No.	Down Dist.	Hash Mark	Type Play	Form.	Play	Yard-age	Ball Carr.	Fum.	Score
2	1-10	R	R	PR3	13	+4	FB33	R	0

Figure 5. Example of a "zone" readout appearing in this scouting analysis. The above play run in this zone was the second play of the game, a 1st and ten situation. The ball was on the right hash mark, the type of play was a run from formation PR3, which is the right end split wide, the flanker wide to the left, and the remaining backs behind the offensive tackles. The play was 13, which is the fullback hitting over left tackle for a gain of four yards. The fullback, (FB33), number thirty-three, was the ball carrier, who fumbled but it was recovered (R). There was no score. All the plays were similarly listed under the zones in which they appeared.

The plays were listed under a fifth heading called "down and distance". It is necessary here to explain the down

and distance symbols used in this investigation:

1. 1st and 10 - 1st down and 10 yards to go.
2. 2nd and V.S. (very short) - less than 2 yards.
3. 2nd and S (short) - 6 yards or less.
4. 2nd and L (long) - 7 yards or more.
5. 3rd and S (short) - less than 3 yards.
6. 3rd and L (long) - 3 yards or more.
7. 4th and S (short) - 1 yard or less.
8. 4th and L (long) - over 1 yard.

The sub-headings that appeared under each of the down and distance situations were play number, zone, hash mark, type of play, formation, play, yardage, ball carrier position, ball carrier number, fumble and score. The types of helpful information that often appeared in this readout were:

1. Down and type of play - Did they like to run or pass on this down?
2. Down and formation - Did they lean toward a certain formation on this down?
3. Down and play - What plays did they prefer on this down?
4. Down and ball carrier - Did they rely on a particular ball carrier on this down?

Each down and distance situation was evaluated in the same manner. A typical play appearing under one of these down and distance headings is illustrated in Figure 6 below, with an explanation of items and symbols contained under each column.

Play No.	Zone	Hash Mark	Type Play	Form.	Play	Yard-age	Ball Carr.	Fumble	Score
5	3	M	R	PR8	30	+12	FB33		0

Figure 6, Example of a "down and distance" readout appearing in this scouting analysis. The play (5) was run in

zone three, which is from the minus twenty to the plus thirty-five yard line, from the middle of the field. The type of play was a run from formation PR8, which is the left end split wide left, the flanker tight to the right, fullback behind the quarterback, and left halfback behind the left tackle. The play (30) was the fullback (FB33), up the middle for a gain of twelve yards. There was no fumble or score on the play.

The next heading on the readout combined the "hash marks with each formation". That is, each "hash mark", left, for example, was combined with each "formation" used on that hash mark. The sub-headings that appeared under these combinations were the same as those used under the individual readouts for "hash marks" and "formations", previously discussed. The basic exploration here was that of favorite formations on hash mark locations. All sub-headings were also explored for possible play, formation, or ball carrier preferences.

The "mileage chart" appeared as the next heading. This category of information was a breakdown of yardage gained at various points of attack (holes) along the line of scrimmage. The sub-headings that appeared were play number, down and distance, hash mark, zone, type of play, formation, play, yardage, ball carrier position, ball carrier number, fumble and score. Information of importance gathered here indicated the strengths and weaknesses of the opponent's attack with respect to each hole along the line of scrimmage. Each sub-heading was also further analyzed for possible helpful

information. An example of a play listing under one of the readouts under the mileage chart heading is illustrated in Figure 7 below, with an explanation of items and symbols contained under each column.

Play No.	Down Dist.	Hash Mark	Zone	Type Play	Form.	Play	Yard-age	Ball Carr.	Fum.	Score
1	1-10	M	1	R	EWT	18K	+11	QB18		0

Figure 7. Example of a "mileage chart" readout appearing in this scouting analysis. The play was a 1st and ten situation. The ball was in the middle of the field in zone one, which is from the minus goal line to the minus ten yard line. The play was a run (R) from the EWT formation, which had both ends split and the backs in their normal backfield positions. The play was the quarterback option to the right side that gained eleven yards. There was no fumble or score on the play.

The next heading was the "box score", which was a summation of the individual and total yardage gained. Each back was listed by position with the number of times he carried the ball, yardage he gained, and average yards per carry. This category has been of assistance in pointing the defensive plan to stop a particular ball carrier. An example of this summation appears in Figure 8, on page number thirty five (35), with an explanation of items contained under each column.

	Number of Carries	Yardage Gained	Average Yards Per Carry
Quarterback	11	112	10.1
Left Halfback	18	167	9.2
Fullback	13	44	3.3
Right Halfback	10	11	1.1
Totals	52	334	6.4

Figure 8. An example of a "box score" readout appearing in this scouting analysis. The quarterback carried the ball eleven times, gained 112 yards for a 10.1 average per carry. The left halfback carried eighteen times, gained 167 yards for a 9.2 average. The fullback had thirteen carries, 44 yards and a 3.3 average, while the right halfback gained eleven yards on ten carries for an average of 1.1 yards per carry. This illustration indicated that more emphasis must be placed on stopping the quarterback and left halfback than the other ball carriers.

The "passing game" was the next area analyzed in this scouting process. The sub-headings that appeared under this heading were play number, down and distance, formation, yardage, type of pass, pass route, pass zone, pass success, receiver number and receiver position. The primary value gained from this breakdown was the indication of favorite receivers and pass routes. A typical example of a play that appeared in this category is illustrated in Figure 9, on page number thirty six (36), with an explanation of items and symbols contained under each column.

Play No.	Down Dist.	Form.	Yard-age	Type Pass	Pass Rte.	Zone	Pass Succ.	Rec. No.	Rec. Pos.
27	3-L	PR3	+19	DB	CL	C	C	87	LE

Figure 9. Example of "passing game" readout appearing in this scouting analysis. The play was number twenty-seven, in a 3rd and long situation, ie. over six yards. The formation was PR3, which was the right end split, the flanker wide to the left, and the remaining backs behind the offensive tackler. The play gained nineteen yards on a straight drop back pass (DB). The pass route run by the man that caught the ball was a curl (CL), where he released about ten yards deep and curled back to his inside. The ball was thrown to pass zone (C) (diagrammed in advance on the scouting form on page 20). The pass was complete (C) to receiver number 87, the left end.

The previous readout headings all pertained to the opponent's offensive scouting information. The next heading that appeared on the readout dealt with the kicking game. The "kicking game summary", which was the only heading related to the kicking game, was of value only in checking out the punting average of the team scouted. This item of information was of importance in planning the punt return portion of the game plan. This simple readout is illustrated in Figure 10 below, with an explanation of the figures contained under each column.

Number of Punts	Total Yardage	Ave. Yds. Per Punt
8	198	24.7

Figure 10. Example of "kicking game summary" appearing in this scouting analysis. The readout indicated, obviously, that the team punted 8 times for 198 yards and a 24.7 average.

The information about the opponent's defensive alignments was treated similarly to the offensive data, outlined in the preceding paragraphs, except that headings were confined to "down and distance", "hash mark", and "zone". Any tendencies displayed through this defensive analysis were taken into consideration in formulation of the offensive game plan. For example, if the team showed a preference to cover a split end with two people in a certain down and distance situation, the quarterback was instructed to run the option play to the split end side. The defense weakened itself against this play action with this particular defensive adjustment.

All scouting data, when collected and analyzed, was put into use in formulation of the game plan. The following section deals with the use of this processed scouting data.

III. USE OF PROCESSED INFORMATION IN COACHING

The information, processed under the 12 headings of this process of computer analysis was put to use by the coaching staff. Each heading provided specific information in formulation of the game plan. This section is a brief presentation of how our coaching staff used

information categorized by the computer under each heading.

The "numerical, chronological play by play" was used to determine specific patterns of play used by an opponent. It was of extreme importance in planning the defenses for a game if, for instance, our team knew that the opponent liked to start each series of downs, or each time they gained possession of the ball, with a particular play or series of plays. They may have shown a particular pattern of play when ahead or behind in the score. If they used special blocking or special plays from odd formations, it appeared on the comment cards used following those particular plays. For example, it may have been learned that a back cheated on his alignment for a particular play (moved up when he was going to block, moved back when he was going to carry the ball, or aligned other than normal when going out for a pass), information which may have assisted the defense in identifying what play would be run from the cheated alignment, or what specific blocking pattern would be used with a special play series. A team may have shown a favorite or special play that it ran from certain "formations" and, if successful, was repeated often. However, if these

special plays were stopped the first time they were run, they may not have been repeated during the remainder of that game. In addition to these points, this initial readout was used as a reference for specific data pertinent to each individual play.

A listing of formations with plays run from each was important in determining plays that must be stopped in each formation. The defensive game plan began to take shape here, in that, basic defenses were adjusted to meet opponent's strengths from these formation tendencies. It was found, for instance, that some teams passed from one formation and ran from another, which was found to be most helpful information when setting up the defensive game plan.

The "hash mark" readout was of great assistance if it showed that a team preferred running to the wide side of the field. There were also occasions when they showed preference to running to the short side of the field. When the ball was in the middle of the field, did they show a right or left-handed tendency? This was usually influenced by their best ball carrier and if he was the right or left halfback. Many teams displayed a tendency to be right-handed if nothing else, relative to lateral east - west position on the football playing field.

The readout displaying the plays from "zones" (north-south field position) was usually helpful in adjusting the defensive game plan to field position locations. It was possible to gang up on a team that didn't like to pass when their backs were against the wall. Many teams also had favorite plays in certain field position situations.

The opponent's offense vs. "down and distance" was also helpful in adjusting the defensive plan to down and distance situations. Some teams did not pass on 1st down, or ran a specific play or plays in certain down and distance situations. Many of them had a favorite ball carrier on certain down and distances.

The "formation and hash mark" readout was a combination of two previously explored categories of information. Many times a team displayed a tendency to place formation strength to the wide side of the field. This, coupled with the information or tendencies displayed in the individual readouts, was of additional assistance in formulation of plans.

The "mileage chart" was simply a tally of all plays that attacked each hole along the line of scrimmage. This often coincided with the favorite plays and ball carriers, which helped confirm the defensive adjustments made to stop favorite plays and players in certain formations.

The "box score" acted to verify the information printed

earlier in the report relative to favorite ball carrier and potency of the running attack.

The "passing game statistics" indicated the potency of the passing game, favorite receivers and pass routes, which was of assistance in adjusting defensive secondary coverages.

The "kicking game summary" was not especially revealing as to the important items desired about the kicking game. It was simply a summary of the number of punts and yardage per punt. The specific information desired relative to the kicking game was obtained from the scout or the film analysis and has been recommended for further study with this scouting analysis.

The "passing game breakdown" usually indicated their favorite pass receiver or receivers and preferred patterns which allowed the defense to concentrate the defensive strengths and best pass coverages against their strengths.

The opponent's "defensive data" was analyzed in the same manner as described here for offensive information. After all the factors and tendencies were explored, it was possible to place the offensive strengths against the opponent's defensive weaknesses. It was also possible on many occasions to take advantage of opponent's adjustments to certain situations. This was accomplished by using a particular offensive formation that would force the opponent

into a certain defensive maneuver and then by making a change in the normal pattern, if necessary, take advantage of their maneuver with a special adjustment or play to attack the weakness created by the opponent's change.

It might be well to mention that, unless tendencies in the scouting analysis were quite evident or pronounced, it was not a sound policy to make a great deal of preparation based on that particular information. Unless a number of opponent's games were charted and analyzed, tendencies of any value often did not present themselves. It is often more disasterous to prepare game plan information on incomplete or inadequate data than to have no information at all.

The coaching staff would take the charts and information of the most usable and meaningful information from the scouting data made available through this process of analyzation and reproduce them for study by the team. Typical information that was passed on to the players included:

1. Information on personnel by position such as height, weight, age, year in school, strengths and weaknesses. This was done both offensively and defensively.
2. Favorite formations, plays and ball carriers.
3. Any tendencies displayed through the scouting report analysis that were significant. These were often found to be in relation to their offense vs. "down and distance", "zones" and "hash marks".
4. Favorite pass patterns, receivers and types of passes thrown.
5. Meaningful information relative to all aspects of the kicking game.

6. A tip sheet which included clues as to what was expected in specific formations, or from individual personnel.

It should also be mentioned here that this method of scouting report analysis has been used in a self-evaluation process. This process revealed as many tendencies about ourselves as it did about opponents. This information was of value in balancing our own attack to make it more difficult to play against. The discovery of these tendencies also assisted us in confusing an opponent who had scouting data upon which he was basing his game plan.

The final chapter contains conclusions pertaining to this investigation and recommendations of possible expansion in the use of computers with respect to football scouting.

CHAPTER III

CONCLUSIONS AND RECOMMENDATIONS

The purpose of this investigation was to develop a scouting form on which to record data required for complete evaluation of football opponents, and development of a system for rapid assimilation of this data into meaningful, useful information. The system was developed during the summer of 1966 and used during the 1966 football season. The season record for Montana State during 1966 was 8 won and 2 lost. The team also participated in the Western Regional National Collegiate Athletic Association College Division Playoff, and although the team lost the game, it ended up being ranked number two nationally. It is difficult to assess the part that this scouting analysis played in this success, but it would have to be said that it represented a major contribution to the football program.

I. CONCLUSIONS

This method of analyzing and using scouting information was found to be of considerable value to the coaching staff in that it allowed the scouting information to be at the disposal of the coaches much earlier in the week than had been possible when information was prepared manually. During the season in which the plan under investigation

was used, the information was available for formulation of the game plan by Sunday afternoon following a Saturday game, as opposed to Wednesday when it was prepared manually. The material was, therefore, issued to the football team early enough in the week so that they could become completely familiar with the scouting information. The time involved in processing the data, then, became a valuable asset to this process of scouting analysis. As a result, the coaches had more time to analyze the information and prepare the game plan.

Secondly, this process made available more combinations of information than would have been possible if analysis had been done manually.

This scouting analysis was also found to be of considerable importance as a method of self-evaluation. The tendencies that were displayed in this self-evaluation were available to the coaching staff and were used to advantage in game plan preparation for future opponents. For example, if the evaluation showed a tendency to run favorite plays from particular formations, and the staff knew a future opponent had scouted that game, adjustments were made to run plays the opponents hadn't seen from those formations.

II. RECOMMENDATIONS

There are additional items of scouting information which, at the present time, are being recorded manually by the scouts, or members of the coaching staff through film analysis. Through continuous investigation and application of this system of scouting analysis, it may be possible to print out additional data which would further assist the coaching staff in formulation of game plans.

Usable data with respect to personnel; height, weight, age, experience, toughness, mobility, relative speed and ability, strengths and weaknesses may possibly be programmed for computer analysis.

Specific keys that defensive linebackers may be using to stop the offensive attack may also be incorporated. That is, who do they watch to get direction as to where to go on specific offensive play actions? The execution of opponent's defensive responsibilities and variations in defensive alignments may also be explored. This could include their defensive philosophy against the running and passing game. Additional combinations of defensive information may be possible through continuous experience with the system that may be of added value.

The kicking game could possibly be analyzed to yield information about the type of kickoff used, the distance of

the kick, the type of coverage with its strengths and weaknesses and whatever else may be considered of value by the coaching staff. Similar information with respect to the punt, punt coverage, quick kick, quick kick coverage, field goal and field goal coverage may also be analyzed by this computer process.

It is suggested that further breakdown be made of data relative to the opponent's ball carriers. This summation of information would list the down and distance situations and indicate the number of times each back carried the ball up the middle (from the positions of the offensive guards - inside), off tackle (from the positions of the offensive guards out to the offensive ends), and wide (from the ends - outside). Perhaps this breakdown will produce added information for determining the strengths and weaknesses of opponents. Many other computer applications may be made in football scouting procedures.

APPENDIX

APPENDIX A

STANDARD DATA PROCESSING CARD

