

## The MagicMetric Coaching System

### Background by Dick Mays

The MagicMetric is a player rating system invented by Dick Mays and Jeff Gantner, two friends who were both mathematicians and basketball enthusiasts. The reason the metric was invented was to remove arguments about playing time among players on an Industrial League basketball team. Everyone on the team had paid \$50 and there was a logical argument that all players deserved equal playing time for their money. To be competitive, the best players needed to be on the court a higher percentage of the time. If some players were to get more playing time than others, then there had to be a justification for it.

Dick and Jeff researched existing metrics, such as TENDEX, and were surprised to discover very little formal reasoning was used to determine the relative value of the various types of contribution on the basketball court. Being mathematicians, Dick and Jeff created their own measurement, called the Magic Metric, to be used to value the contributions of players relative to each other: Another paper describes the reasoning behind the values used in the Metric. It can be found here;

<http://www.upct.es/~beside/Textos/MagicMetric.pdf>

After establishing a way of measuring the relative contribution of players, the problem remained as to how to divide playing time among the players, so that each player got some time, but that the good players would have more time in close games. However, if the game was a blowout, if either team was way ahead of the other, it was desirable that all players would have approximately equal playing time.

Here is an example rotation schedule which gives better players greater playing time:

Magic Metric Coaching System with Nine Player Rotation

PLAYER Name	Num	20	14	10	6		20	14	10	6	Playing Time
		X	X		X		X		X	X	32
		X		X	X		X	X		X	32
			X	X	X		X	X		X	30
		X		X				X	X	X	24
			X		X		X			X	22
		X		X				X	X		18
			X	X				X	X		16
			X		X				X		14
		X					X				12

The top column has the time on the clock, 20 minutes is the start of the half. The first substitution is at 14 minutes, the next at 10 minutes and the final at 6 minutes. This breaks the half into four separate stretches, 6 minute, 4 minutes, 4 minutes, and 6 minutes in length. The roster is filled out starting with the highest player on down to the lowest player. Where an X appears in the column, a player will be in the game during that time interval. The total playing time for each player is shown in the right hand column.

This rotation gives more playing time to the better players, and less playing time to the lesser skilled players. However, if the game is not close, the last period can be adjusted for a blowout situation to give the less skilled players more playing time as shown:

Magic Metric Coaching System, Nine Player Blowout Rotation

PLAYER Name	Num	20	14	10	6		20	14	10	6	Playing Time
		X	X		X		X		X		26
		X		X	X		X	X			26
			X	X	X		X	X			24
		X		X				X	X		18
			X		X		X			X	22
		X		X				X	X	X	24
			X	X				X	X	X	22
			X		X				X	X	20
		X					X			X	18

7,8, and 10 man rotations

The nine man rotation is show in this paper. Jeff and I feel it is the optimal rotation to use for competitive play. However, there can also be other rotation schedules when there are fewer or more players. In an recreational league, it is often unknown how many players will show up for the game, so one of the nice features of the rotation system is that it allows the coach to fill out the roster at the last minute but the players can look at the roster and know when they will be in the game. They can then pace the expenditure of their energy accordingly.

This rotation system was used for eight and a half years in a combination of Church, YMCA and Industrial leagues, with almost 100 games being played using this coaching system. The system was designed to provide an equality of playing time rather than field the most competitive team possible; however, we discovered a “big surprise.”

## THE BIG SURPRISE

Although it was not the intent of the rotation system to field the most competitive lineup, our winning percentage increased dramatically when the system was used. Exactly why this is the case can't be completely explained; however, some facts are as follows.

The first year the system was used in one Church league team, it had a number of detractors. The detractors argued that a random lineup without regard to the various positions (Guards, Forwards, Centers) would be less optimal than intelligent coaching. Intelligent coaching is the process whereby a coach watches the ebb and flow of the game, makes strategic substitutions, and giving consideration to individual match ups. The detractors were convinced that the blind rotations called for by the spreadsheet resulted in lineups that made little sense. However, in the first four games of the season we used the rotation and won two and lost two. As the detractors grew louder, we abandoned the system and lost the last eight games of the season.

The next season, and for several seasons to follow, the system was used by the Winder Methodist Church team. Older players left, and at one point we had a team made up mostly of younger players, many of them in high school. Jeff and I, both in our forties, were the only "old guys" left playing on the team. This core team played for three consecutive seasons and finished 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> in the league. As Jeff and I watched our metric slowly decline as the younger players metric increased. Eventually coaching control was handed over to the younger players who had matured into young men, many now in college. These young men included some very good players, but they chose to revert to a more traditional approach of starting the best five players and substituting individually when players were tired. The same team which had finished in 3<sup>rd</sup> place with a 7-3 record the previous year, finished the new season with a 1 win and 9 loss record.

After using the system to play many, games over several seasons, there are a number of theories that Jeff and I have to explain why the system appears to work so well. We have given these concepts names and explanations as follows.

### *The Finishing Five*

One hurdle that must be overcome is the glamour normally reserved for the "starting five." Traditionally the best five basketball players start together. The MagicMetric rotation finishes with the strongest five players, so we call them the "finishing five." The original reason for ending the game with the finishing five was to give more equal playing time to the other players, whenever there was a blowout situation. However, there appear to be several side benefits to finishing with your strongest players. Four benefits of the finishing five include:

- 1) Opponents underestimate team
- 2) Players fresher at the end
- 3) More shots for the shooters
- 4) Kinetic Wildcard

We only lost a lead once during the final six minutes when we played with the rotation system. However, there were many games where we entered the final six minutes behind on the scoreboard.

#### Factoid:

The rotation system was used with almost hundred games played. Only one time did our team lose a lead that it had with six minutes left to play in the game. In the ten game season with the 1-9 record, four games were lost with a lead at the six minute mark.

Reasons one and two go hand in hand. Since the opposing team never sees our strongest lineup until the last six minutes of the game, they often play a little more recklessly as they may feel that their personnel are stronger than our team. When they finally do see our strongest five players on the court at the same time, our players are fresher since their best players have often played almost all of the thirty four preceding minutes. Many times, we started making a comeback and watched as the opponent's team chemistry falls apart under the pressure of losing their lead..

The third factor is more shots for the shooters. When you start your best five players, you usually are starting your best three scorers. Sometimes, scorers feel like they should be putting up shots. If you have too many in the game at the same time, sometimes they take a shot just to get their share. If you don't play the five best players until the end of the game, the shooters seem to be more patient with the ball.

The fourth factor we call the kinetic wildcard. When you start a player who is only going to play ten minutes in the entire game, he can play with more reckless abandon. He can expend his energy faster, knowing he will not be back in until the next half. This creates a kinetic element in the lineup which can induce the other team into matching the hustle with some higher energy behavior of their own. This results in a more tired opponent.

### *Multiple Looks*

Some people make a big deal about coaches that use a small lineup, or "go big." It happens naturally using the rotation system. The opposing team never sees the same lineup twice and often there is confusion on the part of the opponents as 3 or 4 substitutions occur at the same time. Players learn to play multiple positions, and I often found myself at 5' 10", playing against much taller forwards. You learn the fundamentals, like boxing out when you are forced to play out of position. It makes you a better, more well rounded player.

**Factoid:**  
One rotation left us in a four minute period with no one on our team over six feet tall to play center. The opposing team had a 6' 8" center. I played center for four minutes, fouled their big man three times and pushed on him for four straight minutes. We got through the period where we started, down by four. The final six minutes their big man was exhausted and we won by eight.

### *Player Accountability*

The rotation system can be used without the MagicMetric being used to determine player ranking. However, when a player's performance is measured and their playing time is affected by the results of that performance, turnovers decrease and shooting percentage increases. We witnessed this time and time again.  
*(The coach of the Gainesville High School women's team won the state championship using a modified version of the nine player rotation)*

**Factoid:**  
In an Industrial league, we had a very talented player, Carlos, who had once been an excellent ball handler but had gained a little weight and no longer could dribble through double teams effectively. Until his turnovers caused him to fall out of the finishing five, he did not recognize and change his behavior. His metric for the last half of the season was double that of the first five games

## Keeping Statistics

The Magic Metric rotation systems recommends that players are seeded based on their Magic Metric per minute rating. The following formula can be used for high school or college play.

$$MM = 2.45 * FGM + 1.2 * 3GM + .65 * REB + .9 * AST + STL + 1.4 * FTM + .8 * BLK - .65 * FGA - .5 * FTA - TOV$$

FGM = Field Goals Made

3GM = Three point goals made

REB = Rebounds

AST = Assists

STL = Steals

FTM = Free Throws Made

BLK = Blocks

FGA = Field Goal Attempts

FTA = Free Throw Attempts

TOV = Turnovers

When gathering statistics for the Magic Metric, the normal statistics gathered for players are used. These numbers are understood and people already know how to track them. The number of fouls a player received is not deemed relevant to the contribution. Many of the most imposing defense players pick up fouls and it is just as likely that a foul contributes positively in many cases. A Technical Foul or offensive foul are exceptions and are treated as turnovers.

When keeping statistics for a game, we can give credit for some contributions that are not tracked as part of a normal statistics gathering process. Taking a charge, for instance, can be credited the same as a steal. Boxing out a player trying to track down a loose ball, so that it goes out of bounds and to the boxing out player's team, can be fairly treated the same as collecting a rebound.

## Credits

The rotation system is solely the work of Dick Mays. It can be used by anyone freely and without any copyright infringement, but it would be nice if any written description of the system references the author. The MagicMetric is the work of DickMays and Jeff Gantner and all copyrights are reserved for publication of the metric.

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