Universal law of basketball: Duke professor's theory unites physics, engineering, and March Madness

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Many of the top-ranked teams competing in the 2011 NCAA Division I men's basketball championship tournament look familiar.

A small group of teams -- including 2011 number one seeds Duke University and the University of Kansas -- have dominated March Madness for the past 30 years. These schools generally have the best coaches, well-funded training facilities to attract the top talent, and a history of players turning pro.

Professor of engineering and ex-Romanian professional basketball player Adrian Bejan of Duke University said that the appearance of the same teams as top seeds is neither coincidence nor conspiracy. It's a predictable outcome of a complex system. Bejan has developed a theory that can explain everything from March Madness rankings to the formation of river basins. His theory -- known as constructal law -- holds that systems from basketball rankings to arteries and veins to river deltas evolve to follow the path of least resistance.

Imagine a stream of water flowing through the sand, Bejan said. Eventually, the force of that flowing water will create river banks and a basin, which allows the water to flow smoother and faster on its way to the sea. If the water can't wear away obstacles like boulders or trees, it will simply flow around them. Channels will merge into larger waterways, and small streams will split off from the main channel as the river continues to evolve over time.

Although it's easy to visualize water flowing through a riverbed, other systems governed by constructal law are also what physicists refer to as flow systems. Blood flows through arteries and veins. Information flows through the Internet. And talent and skill flow through basketball rankings.

Basketball talent flows through the path of least resistance to the NBA, which traditionally has been through the top-ranked NCAA schools. The significance of constructal law, Bejan noted, isn't the observation that success breeds success in these top basketball schools and that these channels are invariable. Rather, constructal law predicts that the system will continue to evolve to remove obstacles that stand between the most talented players and the NBA.

In recent decades, basketball talent began to bypass the NCAA, as some of the most promising players skipped college ball altogether. Then the

NBA changed its rules to make high school seniors ineligible for its draft. Since the change, a limited number of players have chosen to play professionally in Europe for a year before entering the draft. Bejan said this is "constructal law in action," as the flow of basketball talent to the NBA finds a way to avoid the obstacle of college.

Every year, colleges and universities obtain rankings not just on sports programs, but also on academics and other features. In his paper published in this month's International Journal of Design & Nature and Ecodynamics, Bejan showed that academic smarts flow most efficiently to the same Ivy League schools, just as basketball prowess flows to the same universities and blood flows through arteries and capillaries to deliver oxygen to cells.

"No matter what flows from one point to another," said A. Heitor Reis, a physicist at the University of Évora in Portugal, "if you can identify this flow, you will find that constructal law is behind the flow."

Constructal law organizes all of these systems and dictates what the final arrangement will look like, whether it's the athletic rankings or the athletes themselves.

Jordan Charles, a former student of Bejan, was a varsity swimmer while studying at Duke University when he noticed something interesting about his competitors. "I was standing next to someone on the blocks who was a lot taller and a lot bigger than me," Charles said, "and I thought 'he's probably going to beat me.'"

Charles, now an aerospace engineer at Lockheed Martin in Denver, was right, and not just in that particular instance. A search of historical data showed that the world record-holding swimmers and sprinters had gotten taller and heavier as they had gotten faster.

Using constructal law, Charles and Bejan showed why, on the whole, airplanes can travel faster than horses, which can travel faster than gnats. A larger mass provides more power for the object to propel itself through the air or water. This would mean that taller, heavier sprinters and swimmers would naturally have an advantage -- a small but significant advantage that becomes evident over time.

These small but significant differences form the heart of constructal law. Small initial differences in a basketball team's performance can lead to the significant, entrenched distinctions seen today. So whether you fill in your NCAA tournament brackets by impulse, uniform color, or a deep knowledge of college hoops, the past success of the teams is a variable worth considering.

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