What Does It Mean to Draft Perfectly?

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Introduction

One of the most intriguing recent draft stories is the case of 2011 draft-eligible John Gaudreau, a 5'6" South Jersey native putting up excellent USHL scoring numbers at the time. Ranked 193rd among North American skaters by the NHL Central Scouting Service, he was far from a certainty in terms of being drafted by any team.

Gaudreau was eventually taken with the 104th overall pick by the Calgary Flames, well past the point in the draft where most prospects are expected to become NHL players. This decision would seem to indicate a lack of confidence on the part of the Calgary Flames, but this is far from the truth. A piece in the *Calgary Herald*, written before the start of his NHL career, details the scouting espionage that went into drafting Gaudreau (Cruickshank, 2014). This quote from John Weisbrod, then a scout for the Boston Bruins, is particularly interesting:

> Calgary beat us to the punch. There were people banging their hands on the table, like, 'Oh, we should have taken him a round earlier.' It's a calculated risk. The Flames got Gaudreau in a really good spot.

If the Bruins should have taken him a round earlier, why didn't they? The Bruins attempted to leverage the fact that Gaudreau was a seemingly unknown entity to postpone selecting him. They may have rated him very highly, but they weren't convinced that anyone else had, leading to their decision to wait. They were using game theory, and analysts should model the draft process in a way that reflects these considerations.

Previous Work

Schuckers and Argeris (2015) show that teams outperform NHL Central Scouting rankings when it comes to optimal draft ordering. However, they probably do not outperform each other. Draft decisions are evaluated based on whether one of the best players available was selected, in contrast to the game theoretic framework we present. Tingling et al. (2011) show that draft order matters in terms of predicting future success throughout the first three rounds, after which point the effect diminishes considerably. Schuckers (2011) and Tulsky (2013) construct draft pick value charts with roughly exponentially decaying trends and implications for how trades are constructed. The relative value of draft picks is an important component of this analysis, but we see that it varies based on the player quality available at different points in a specific draft. Additionally, we can frame the decision of waiting to select a good player as maximizing the return on investment of a team's later picks. Sprigings (2016) creates a draft probability model for several highly rated players in the 2016 NHL Draft to inform trading picks to acquire a specific prospect. It is necessary to forecast these probabilities in order to use a game theoretic drafting approach rather than simply selecting the best player available at each pick.

Methodology

All draft position and player value data was scraped from hockey-reference.com. The player value metric used is Career Point Shares (aggregated through the 2015-16 NHL season), which are an estimate of the expected number of points in the team standings that are contributed by each player. Point Shares was chosen for its interpretability as well as being mostly non-negative. When we aggregate and compare these values, we should not penalize teams for picking a subpar NHL player rather than not picking one at all. For this reason, all negative outcomes were set to 0.

Since teams have shown that they approach the draft with game theory in mind, we should construct a notion of drafting that reflects this. We can start by applying the method of backward induction, well-established in the field of game theory ever since the publication of von Neumann and Morgenstern's *Theory of Games and Economic Behavior* in 1944. Backward induction involves calculating optimal payouts from the last to first decision in order to determine a complete, rational set of decisions for any actor.

In the case of drafting, the last decision that a team will make is their last available pick. We can recommend selecting the best player left on the draft board at that point, and then iterate this strategy backwards until their first pick. This ensures that a player is never selected before absolutely necessary, and a team can optimize the aggregate value of the selected players.

A brief historical example can illustrate this point most effectively. Suppose we build a time machine in order to fix one specific team's draft decisions. If we go back to the 2007 NHL Draft and act on behalf of the Philadelphia Flyers, we have the benefit of perfect information, while every other team would act just as they did previously.

We would redo the Flyers' 2nd overall pick, originally used on James van Riemsdyk. One might initially consider the strategy of best player available. According to Career Point Shares (CPS), Jamie Benn was the best player left on the draft board at that point, even though he was selected much later by the Dallas Stars with the 129th overall pick. However, using backward best player available, we realize that we only have to spend the 122nd overall pick on Jamie Benn. As any value pick chart shows, this pick is worth considerably less than the 2nd overall pick, and so we maximize return on investment. Then, we can use the 2nd overall pick on someone like Max Pacioretty. Pacioretty, according to Career Point Shares, is not quite as valuable as Jamie Benn. However, he was picked 22nd overall by the Montreal Canadiens, and so he would not have been available later on in the draft. Table 1 shows a comparison between the Flyers' actual draft selections, recommended selections based on best player available, and the optimal selections when working backwards.

We see that backward best player available outperforms best player available, and both outperform the Flyers' actual draft selections by a wide margin. Additionally, the difference between working forwards and backwards is not particularly large, but it certainly exists. Here, a difference of 20 Career Point Shares implies one expected additional win per season from 2007 till present. In general, if a draft is less predictable and there is value to be had in all rounds, the difference between selecting the best player available working forwards and backwards increases. If the draft is perfectly ordered, both methods yield the same value, which would also be equivalent to the actual result.

Table 1: Optimizing the Philadelphia Flyers' 2007 Draft Selections[1]

Pick	*Actual Selections*	*CPS*	*Best Player Available, Perfect Information*	*CPS*	***Backward** Best Player Available, Perfect Information*	*CPS*
2	James van Riemsdyk	31.6	Jamie Benn	55.8	Max Pacioretty	46.2
41	Kevin Marshall	0.0	P.K. Subban	52.8	P.K. Subban	52.8
66	Garrett Klotz	0.0	Alec Martinez	27.7	Alec Martinez	27.7
122	Mario Kempe	0.0	Jake Muzzin	24.6	Jamie Benn	55.8
152	Jon Kalinski	0.2	Carl Gunnarsson	23.9	Carl Hagelin	21.1
161	Patrick Maroon	9.3	Carl Hagelin	21.1	Carl Gunnarsson	23.9
182	Brad Phillips	0.0	Justin Braun	21.1	Justin Braun	21.1
Totals	***Actual Value Drafted***	***41.1***		***227***	***Perfect Draft Value***	***248.6***

We can calculate this Perfect Draft Value for any team in any year. Then, we can construct a Draft Efficiency score by dividing their Actual Value Drafted by their Perfect Draft Value. For the Flyers in 2007, this score is 41.1 total Point Shares divided by 248.6 possible Point Shares, or about 16.5%. This is a simple yet effective measure of how much value any team ended up extracting from the draft relative to their own best case scenario. Draft Efficiency helps to diminish some of the advantages inherent to having many high-value picks in a certain draft, because the benchmark of opportunity for those teams becomes higher.

This approach does raise some questions of feasibility. Taking the time machine scenario too seriously will lead to some impossible hypothetical scenarios. What if picking Jamie Benn before Dallas in 2007 causes Dallas to take Carl Hagelin, one of the next players prescribed by the perfect draft? After all, it would be incredibly difficult to take the "butterfly effect" into account. Furthermore, what if taking Benn before Dallas causes him to stall in his progress? Assuming player outcomes are fixed ignores their inherent uncertainty as well as the impact of NHL coaching and development programs.

We should consider an alternative understanding of the Perfect Draft that best captures its evaluative purpose. The Perfect Draft shows the value that all other teams were able to select and develop at various points in each draft. It shows what could've happened if a GM did everything right, and probably also got a bit lucky. It will never be a perfect metric until we simulate multiple trials of reality, but it certainly helps to tease out the inherent biases of fans and analysts when they evaluate drafting more qualitatively. Furthermore, this approach can be used with any valuation metric in any league with a draft.

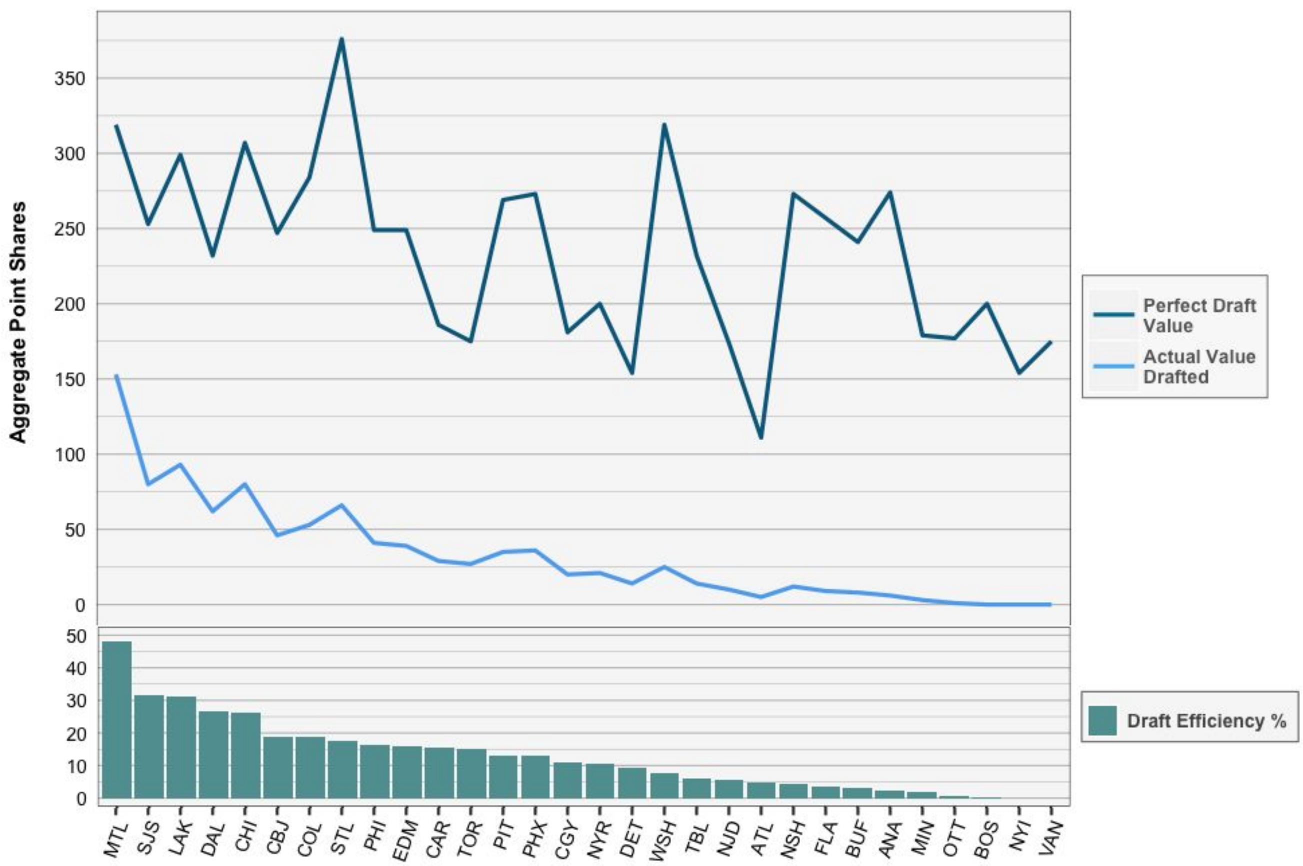
[1] Note that because Gunnarsson and Hagelin were both selected after the 161st overall pick, it does not matter whether they are picked 152nd or 161st overall in this redraft.

Results

Figure 1 shows Draft Efficiency results for the 2007 NHL Draft. Teams are ordered by their Draft Efficiency score, from best to worst. Montreal does better than any other team by extracting roughly 50% of the value that was available to them. At the other end of the spectrum, the Islanders and the Canucks drafted no successful NHLers. It is notable that the Canadiens had three more picks than the Canucks and four more picks than the Islanders, and Montreal's picks were on average about one round better than those of both teams. The Canadiens clearly had more and better opportunities to extract value from the draft, and they were able to take advantage of them.

We find that Perfect Draft Value correlates positively and linearly with Actual Value Drafted (r = 0.45) throughout the 2000-09 drafts. Still, there is clear variation. Montreal is ranked first in Draft Efficiency for 2007 while Washington is 18th, despite having equivalent Perfect Draft Values. Washington is penalized for not taking advantage of their good picks, and they are ranked below a handful of teams whose selections weren't as valuable in an absolute sense.

Figure 1: 2007 Draft Efficiency Results

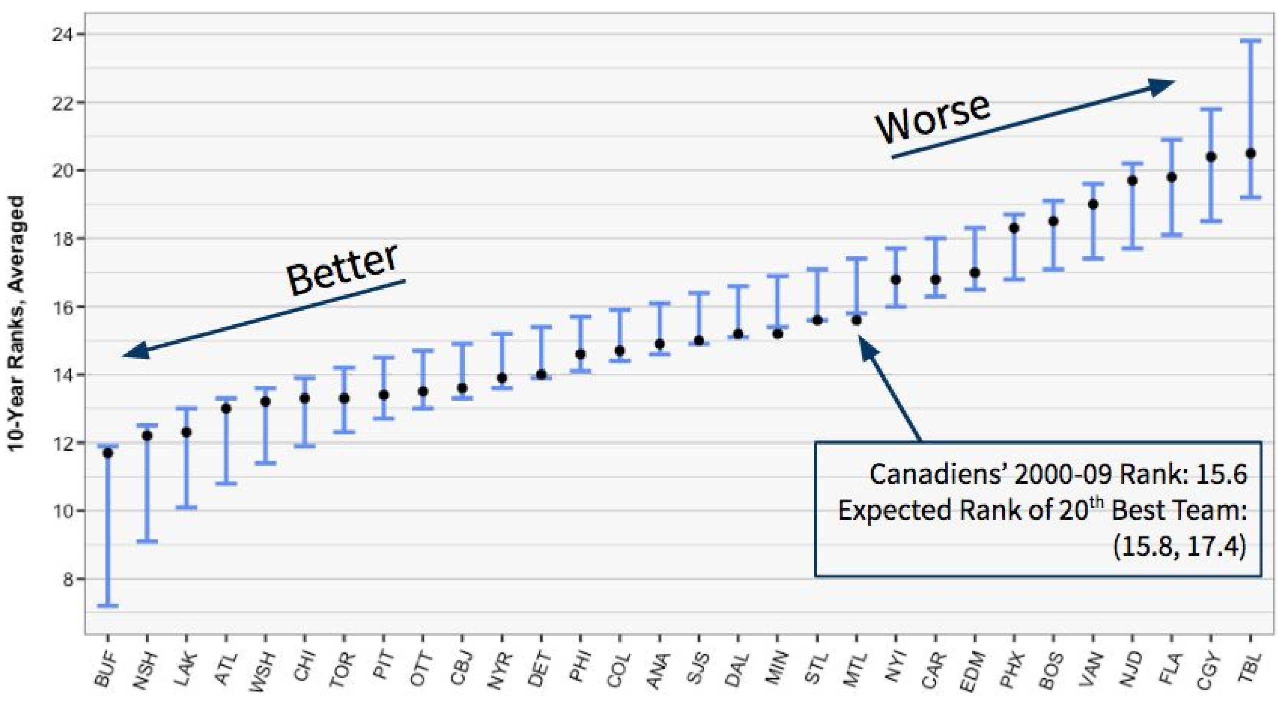


It's important to note that every draft is different and has a unique distribution of Draft Efficiency scores. In some years, one team does particularly well, and so everyone else suffers in comparison. Other years, especially earlier on in the sample, exhibit more parity in drafting. For this reason, we compare team ranks instead of raw Draft Efficiency percentages for the entire decade. Every year is different, but in every year each team still wants to do better than their opponents.

If we evaluate the results over 2000-09, no team does significantly better or worse when regressing team on Draft Efficiency rank. To further understand if there are trends in the rankings, we can repeatedly simulate ranks over 10 years to construct 95% confidence intervals for our expectations of the best team, the second best team, and so forth, in a world where every team is equally proficient at drafting. Figure 2 displays the averaged actual rankings, which are basically in line with what would be expected from randomly generated results, with a couple exceptions. The top 20 teams display regression to the mean. The best teams perform systematically worse than we might expect, and the middle of the pack teams perform systematically better than we might expect. The Canadiens are singled out in Figure 2 below, with an average rank of 15.6 that slightly outperforms the 95% confidence interval for the 20th best team, (15.8, 17.4). In addition, there is some separation between the top 20 and bottom 10.

While placing in the bottom third of the league could be due to bad luck, there is some evidence that these teams were making subpar draft decisions. Calgary's decision to draft Gaudreau in 2011 was a departure from their draft strategy in the 2000s, when they were fond of drafting bigger players (Cruickshank, 2014). Largely due to drafting the small, skilled Gaudreau, they rank 3rd in 2011 Draft Efficiency, a better result than they were able to achieve at any point within the previous decade.

Figure 2: Expectations for Draft Efficiency Ranks



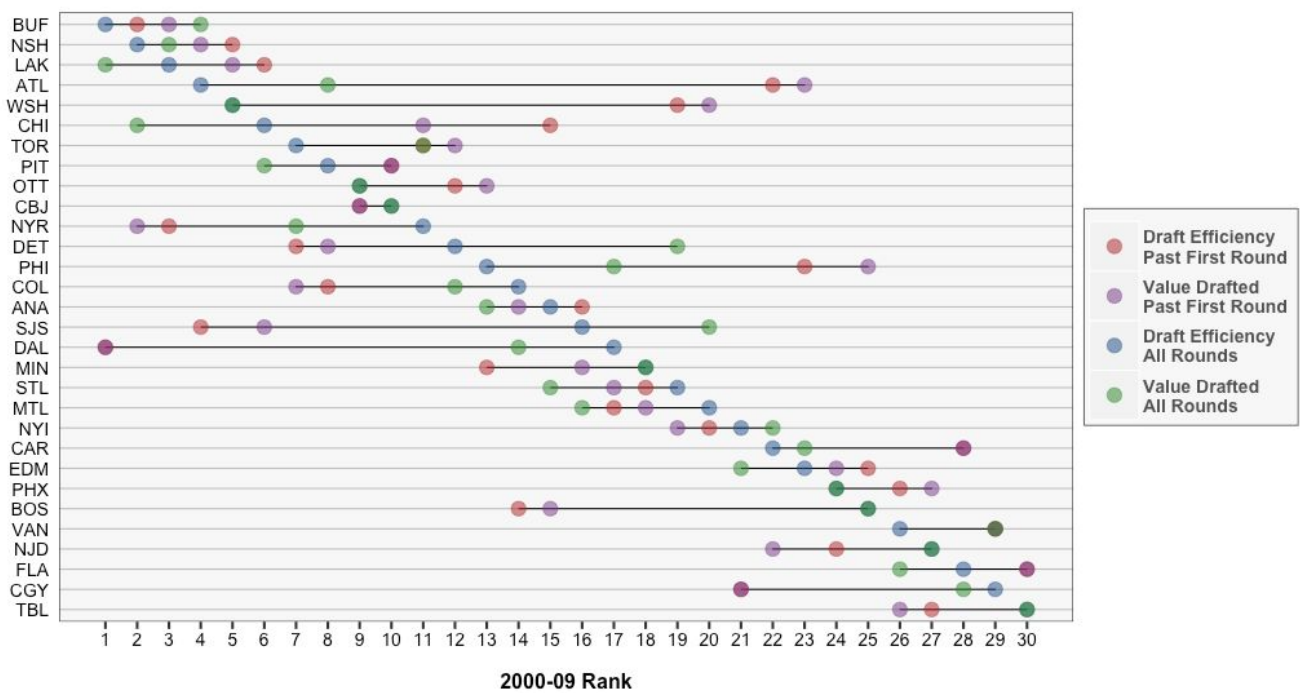
What Does It Mean to Be "Good at Drafting?"

It's hard to talk about drafting success in the 2000s without mentioning the Chicago Blackhawks. With notable drafted talents such as Patrick Kane, Jonathan Toews, Brent Seabrook, Corey Crawford, Duncan Keith, and more, they tend to fall at or near the top of any lists of the best drafting teams in hockey. According to averaged Draft Efficiency rank, they are 6th in the NHL over this time period, which already seems a low given their tremendous on-ice success.

However, during the 2000-09 drafts, they had at least 9 more picks than any other team, including the first overall pick in 2007, third overall in 2006 and 2004, and more. For every Jonathan Toews the Blackhawks drafted, they made a selection like Kyle Beach, who failed to make an impact at the NHL level. If we rank teams simply based on the total Point Shares they drafted in each year, the Chicago Blackhawks are 2nd in the 2000s. However, using Draft Efficiency penalizes their performance the most out of all teams because their Perfect Draft Values are particularly high.

One of the other ways to eliminate the advantage of having high-value picks is to ignore the ones that are allocated via lottery. Schuckers (2011) and Tulsky (2013) find that these are the most valuable picks by a large margin. The 1st overall pick, for example, often involves a yearlong "tanking" effort, and so it is generally unattainable for playoff-bound teams. If we eliminate the first half of the first round, then, in the interest of fair comparison, we should exclude the entire first round. Doing so yields similar rankings for some teams and dramatically different ones for others. Figure 3 displays some of the disparities in rankings among four possible systems. Teams have a total value ranking and an efficiency ranking for the entire draft as well as for the second round and beyond. The ranking systems are ordered in the legend from most to least penalization of pick value.

Figure 3: Team Performance Under All Ranking Systems



Now, we get to the heart of the issue of why teams like the Blackhawks as well as teams like the Red WIngs are considered good at drafting. The Blackhawks drafted a lot of high-value players, but also had a lot of misses, and so they are penalized with all efficiency-based measures. They go from 2nd in the league to 15th as we take away their relative advantages. Meanwhile, the Red Wings were fairly mediocre in terms of value drafted, but they did an excellent job of efficiently extracting value from their not-so-great picks. They have the opposite trajectory in rankings, going from 20th to 4th in the NHL as other teams' pick advantages are removed.

This analysis lends credibility to the idea that teams should set themselves up to succeed by accumulating many high-value draft picks. Then, even if they're roughly average at finding value in all rounds of the draft, they still perform very well in absolute terms. This is the rationale for strategies like "The Process" of the Philadelphia 76ers in the NBA (Hinkie 2016).

Future Work

The first question to ask about any draft research is "can this help a team draft better?" This project is mostly descriptive and retrospective in nature, but it can at least serve as a warning sign for teams who are doing particularly poorly. Of course, they often know this already due to lack of on-ice success, although having high picks for a few years can help to mask deficiencies.

There are ways to incorporate these ideas more prospectively into future draft strategies. First, teams need to model outcomes for each prospect, which is presumably being done by each team to some degree. Second, a team will need to model the distribution of picks around which a prospect is expected to be selected. Dawson Sprigings' NHL Draft Probability Tool (2016) shows how this distribution can estimated using pre-draft rankings from various sources, but the accuracy of these estimates will drop in later rounds. In general, there will need to be a certain level of precision attainable by this approach before it becomes better than simply selecting the best player available.

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