EPD Basics:
What They Are and How to Use Them

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Expected progeny differences (EPDs) are one of the most useful tools cow-calf producers have at their disposal. The usefulness of EPDs is paramount due to the importance of selecting and purchasing the right bull for the commercial or purebred operation.

Yes, even commercial operations can use EPDs in sire selection. In the past the perception was that EPDs were only for the purebred folks or bigger producers. Not so anymore, primarily due to the fact that the beef industry has evolved into one that covets information now more than at any time in its history.

One of the results of this change is more and more bulls are sold with EPD information than in the past. Having this data is a good thing because it provides one more tool to a potential buyer to ensure he or she purchases the right bull and will be happy with the results. However, it is my contention that because EPDs are so prevalent in our industry, we reference them in conversation without really knowing what they are and, more importantly, how to use them.

What are EPDs?
Simply put, EPDs are an estimate of how a particular bull's calf will perform in certain traits compared to another bull's calf, in that particular breed and when bred to similar females before the mating ever occurs. The actual EPD is calculated using information submitted to breed associations and provides a basic representation of the pedigree for that particular bull for the trait of interest. It is very important to realize that EPDs are not static; they will change over time as more and more progeny information is collected, which leads us to another important term: accuracy.

Accuracy is a measurement of how accurate or reliable an EPD is. It is measured on a scale from 0 to 1, the higher the number, the greater the accuracy. Accuracies are important when assessing existing bull batteries that may have animals of varying ages and when looking at pedigree information. However, when actually making purchasing decisions, most of the pool of animals you will be selecting from will be relatively young, having produced no progeny, and therefore will have relatively low accuracies for their individual EPDs. This is where going back and looking at pedigree EPDs and accuracies for potential purchases become useful.

EPDs are a prediction of the genetic transmitting ability of an animal. They tell in a given environment how one animal will compare to another; they do not estimate actual weights, only weight differences. An animal's genetic value does not change over time, but the amount of information we have to estimate that value does. The difference in that animal's true genetic value and the predicted value is known as accuracy. EPDs with a higher accuracy have less chance of changing far from their predicted value. It is also important to realize that the EPD value is reflective of the average of an animal's calves and could represent a wide range.

The calculation of EPDs incorporates the relationship between all animals in the analysis, records submitted on all related animals and the value of correlated traits (the manner in which traits affect one another). An animal's own records also play a role in his EPD. This individual performance is all based on each animal's ratio within his contemporary group.

How do you use them?
First of all, the process involves outlining your goals and objectives. This enables you to hone in on those traits that are most important to your operation, and therefore will allow you to select a bull that meets those objectives. For example, let's assume you are a producer who places priority on weaning weight. You have two bulls to choose from within the chosen breed that will complement your cow herd. Figure 1 shows that the weaning weight (WW) EPDs for Bull A and Bull B are 37 lb. and 56 lb. respectively, and their accuracies are about the same. What does this mean? It means that on average Bull B will sire a calf that will wean, at the same age, 19 lb. (56-37=19) heavier than a calf sired by Bull A when bred to a similar set of cows. OK, but is that good or bad?

In order to answer that question, you need another very important piece of information, which is the percentile breakdown charts found in the sire summary for your breed of choice. This chart allows you to look at the breed as a whole and determine where an individual's EPD fits within the breed. As you can detect from Figure 1, Bull B is in the top 10% for weaning weight within the breed. The choice of which sire to purchase is pretty clear, isn't it? Perhaps not, because we have only looked at one trait for the bull in question.

Hereford EPDs

The American Hereford Association (AHA) measures 11 traits and calculates four profit ($) indexes. The Hereford Sire Summary, which is distributed each spring, provides breeders with a tremendous amount of information on a large population of Hereford sires. A comprehensive sort of Hereford sires can also be done online at *Hereford.org*.

The current suite of Hereford expected progeny differences (EPDs) and $ indexes includes:

Calving Ease – Direct (CE)
CE EPDs are based on calving ease scores and birth weights. More positive EPDs are favorable and indicate easier calving. The EPD for direct calving ease indicates the influence of the sire on calving ease in purebred females calving at 2 years of age. In the sire summary, an EPD in a black box indicates that the bull is a trait leader.

Birth Weight (BW)
Progeny of the sire above can be expected to weigh an average of 3.2 lb. more at birth than progeny sired by a bull with an EPD of -1.0 lb. (2.2 minus - 1.0 = 3.2 lb.). Birth weight is an indicator of calving ease. Larger BW EPDs usually, but not always, indicate more calving difficulty. The figure in parentheses found after each EPD is an accuracy value or reliability of the EPD. To learn more about how to use accuracy when evaluating EPDs please refer to the section "Accuracy and Confidence Range" in the Spring 2009 Sire Summary.

Weaning Weight (WW)
WW EPD reflects pre-weaning growth. Calves sired by a bull with a +30 WW EPD should have a 20 lb. advantage in 205-day adjusted weaning weight compared to calves sired by a bull with an EPD of +10 lb. (30 minus 10 = 20 lb.).

Yearling Weight (YW)
YW EPD reflects differences in the 365-day adjusted yearling weight for progeny. It is the best estimate of total growth.

Maternal Milk (MM)
The milking ability of a sire's daughters is expressed in pounds of calf weaned. It predicts the difference in average weaning weights of sires' daughters' progeny due to milking ability. Daughters of the sire with a +14 MM EPD should produce progeny with 205-day weights averaging 24 lb. more (as a result of greater milk production) than daughters of a bull with a MM EPD of -10 lb. (14 minus -10.0 = 24 lb.). This difference in weaning weight is due to total milk production during the entire lactation.

Maternal Milk & Growth (M&G)
Maternal Milk & Growth reflects what the sire is expected to transmit to his daughters for a combination of growth genetics through weaning and genetics for milking ability. It is an estimate of daughters' progeny weaning weight. A bull with a 29 lb. M&G EPD should sire daughters with progeny weaning weights averaging 19 lb. heavier than progeny of a bull's daughters with a M&G EPD of 10 lb.

(29 minus 10 = 19 lb.). It is equal to one-half the sire's weaning weight EPD, plus all of his MM EPD. No accuracy is associated with this since it is simply a mathematical combination of two other EPDs. It is sometimes referred to as "total maternal" or "combined maternal."

Maternal Calving Ease (MCE)
The MCE EPD indicates how easily a sire's daughters will calve at 2 years of age when compared to the daughters of other sires.

Scrotal Circumference (SC)
Measured in centimeters and adjusted to 365 days of age, SC EPD is the best estimate of fertility. It is related to the bull's own semen quantity and quality, and is also associated with age at puberty of sons and daughters. Larger SC EPDs suggest younger age at puberty. Yearling sons of a sire wth a .7 SC EPD should have yearling scrotal circumference measurements that average 0.7 centimeters (cm) larger than progeny by a bull with an EPD of 0.0 cm. In the Hereford genetic analysis, a multiple-trait model was used for scrotal circumference. Weaning weight was used as a predictor variable to increase the prediction accuracy of SC EPDs. Therefore, an animal with a weaning weight EPD should also have a SC EPD.

Rib Fat (FAT)
The FAT EPD reflects differences in adjusted 365-day, 12th-rib fat thickness based on carcass measurements of harvested cattle. Sires with low, or negative FAT EPDs are

Remember, single-trait selection has gotten us into trouble in the past, and we don't want to revisit history. To avoid extremes in any one trait, be aware of and comfortable with all of a bull's EPDs that are important to you before making the purchase. EPDs are a tool that can make us better managers if we know how to use them, what their limitations are and if they are used in conjunction with other pertinent information. If you are interested in learning more about EPDs, I suggest picking up a sire summary for your breed of choice and familiarizing yourself with it prior to purchasing your next bull.

It's hard to believe in this day and age there still exists a good deal of mistrust and misunderstanding when it comes to EPDs. As a purebred breeder, it is critical to not only understand the application of EPDs, but also how they are calculated. I don't mean the specific statistical methodology, but rather how the data you submit affects the EPDs of your cattle. If you read no further, remember this: EPDs work, but only with complete data submission and proper contemporary grouping.

Contemporary grouping is how environmental differences are removed from the genetic equation. A given sire's calves will not weigh the same at birth in Texas versus North Dakota, and it would not be fair to compare the weight of a calf on feed with one that isn't. A contemporary group is a group of animals raised together under the same conditions. When you report weight information, it is critical to properly define contemporary groups. Only calves managed similarly should be assigned the same contemporary group code. The system will further break contemporary groups by sex and age.

Maintaining large contemporary groups is vital to the effectiveness of the genetic evaluation system. Ratios are calculated within contemporary groups, and this is how the genetic differences are determined. Single-animal or single-sire contemporary groups are of little value in determining genetic differences. The best way to ensure an accurate genetic evaluation is to keep contemporary groups large and properly identify them using management codes. It's also important to use a mixture of both high-accuracy reference sires and young sires in each contemporary group. EPDs are by far the best prediction of performance we have, but they require complete data submission and proper contemporary grouping to maximize their effectiveness. **HW**

Figure 1: Averages and Percentile Breakdown — Active Sires*

	CE	BW	WW	YW	MM	MG	MCE	SC	FAT	REA	IMF	BMI$	CEZ$	BII$	CHB$
Averages															
Avg	0.0	3.5	43	70	17	38	0.7	0.6	0.002	0.19	0.03	15.14	14.22	13.98	18.31
Low	-27.8	12.7	-16	-24	-12	-10	-10.9	-0.7	0.147	-0.83	-0.57	-2.08	-13.65	-4.64	-7.64
High	14.0	-6.1	87	137	52	72	13.6	2.9	-0.110	1.44	1.04	42.17	30.16	40.87	40.28
Percentile Breakdown															
Upper															
1%	7.4	-1.9	68	114	33	58	6.4	1.6	-0.063	0.78	0.48	28.90	23.10	27.08	31.57
2%	6.5	-1.2	64	108	31	56	5.7	1.5	-0.053	0.71	0.39	26.47	22.09	24.70	29.96
3%	6.0	-0.7	62	104	29	55	5.3	1.4	-0.048	0.66	0.35	24.93	21.48	23.20	28.95
4%	5.6	-0.3	61	101	28	54	5.0	1.3	-0.045	0.64	0.32	23.70	20.84	22.32	28.03
5%	5.3	-0.1	59	99	27	53	4.8	1.2	-0.042	0.60	0.30	22.79	20.42	21.46	27.35	← Bull B
10%	4.1	0.9	(56)	92	25	49	3.8	1.1	-0.031	0.51	0.21	20.52	18.83	19.06	25.09
15%	3.2	1.4	53	88	23	47	3.1	1.0	-0.025	0.45	0.16	19.17	17.93	17.67	23.78
20%	2.6	1.8	51	85	22	46	2.7	0.9	-0.020	0.40	0.13	18.21	17.14	16.77	22.79
25%	2.2	2.2	49	82	21	44	2.2	0.8	-0.016	0.36	0.10	17.36	16.56	16.11	21.83
30%	1.7	2.5	48	80	20	43	1.9	0.7	-0.013	0.32	0.08	16.80	15.94	15.53	21.05
35%	1.2	2.8	47	77	19	42	1.6	0.7	-0.009	0.28	0.06	16.23	15.47	15.05	20.24
40%	0.8	3.1	45	75	18	41	1.3	0.6	-0.006	0.25	0.05	15.65	15.06	14.55	19.53
45%	0.5	3.3	44	73	18	40	1.0	0.6	-0.003	0.21	0.03	15.17	14.65	14.11	18.84
50%	0.1	3.6	43	71	17	38	0.7	0.5	0.000	0.18	0.01	14.68	14.19	13.65	18.22
55%	-0.3	3.8	42	68	16	37	0.4	0.5	0.003	0.15	0.00	14.25	13.77	13.23	17.59
60%	-0.7	4.1	40	66	15	36	0.1	0.4	0.006	0.12	-0.02	13.84	13.36	12.80	16.96
65%	-1.1	4.4	39	64	15	35	-0.2	0.4	0.009	0.09	-0.03	13.37	12.92	12.35	16.23	← Bull A
70%	-1.5	4.6	(37)	62	14	34	-0.5	0.3	0.013	0.06	-0.05	12.86	12.46	11.85	15.53
75%	-2.0	4.9	36	59	13	33	-0.8	0.3	0.018	0.02	-0.07	12.37	11.91	11.33	14.75
80%	-2.5	5.3	34	56	12	31	-1.2	0.2	0.023	-0.02	-0.09	11.78	11.36	10.74	13.82
85%	-3.2	5.7	32	53	10	29	-1.6	0.2	0.028	-0.06	-0.11	11.08	10.64	10.04	12.79
90%	-3.9	6.2	30	48	9	27	-2.1	0.1	0.038	-0.11	-0.14	10.19	9.76	9.22	11.49
95%	-5.2	7.0	26	42	6	23	-3.1	0.1	0.051	-0.19	-0.19	8.80	8.37	7.91	9.54
100%	-27.8	12.7	-16	-24	-12	-10	-10.9	-0.7	0.147	-0.83	-0.57	-2.08	-13.65	-4.64	-7.64

*6,287 sires produced at least 10 calves since Jan. 1, 2006. Source: Spring 2009 Hereford Sire Summary.

expected to produce leaner progeny than sires with higher EPDs. Ultrasound measures are also incorporated into this trait and have been shown to be highly correlated with the performance of slaughter progeny. All data is expressed on a carcass scale.

Ribeye Area (REA)
REA EPDs reflect differences in an adjusted 365-day ribeye area measurement based on carcass measurements of harvested cattle. Sires with relatively higher REA EPDs are expected to produce better-muscled and higher percentage yielding slaughter progeny than will sires with lower REA EPDs. Ultrasound measurements are also incorporated into this trait and have been shown to be highly correlated with the performance of slaughter progeny. All data is expressed on a carcass scale.

Marbling (MARB)
MARB EPDs reflect differences in an adjusted 365-day marbling score (intramuscular fat, [IMF]) based on carcass measurements of harvested cattle. Breeding cattle with higher MARB EPDs should produce slaughter progeny with a higher degree of IMF and therefore higher quality grades. Ultrasound measurements are also incorporated into this trait and have been shown to be highly correlated with the performance of slaughter progeny. All data is expressed on a carcass scale.

Baldie Maternal Index (BMI$)
BMI$ is a maternally focused index that has a production system based on 1,000-Hereford x Angus females with a progeny harvest endpoint directed toward Certified Hereford Beef (CHB®). This index is more critical of CE than the Brahman Influence Index (BII$) and also has significant weight on fertility. There is positive weight on WW and a slightly negative weight on YW, which promotes early growth and then a slow down on growth to keep mature size manageable. The emphasis of IMF is greater than the emphasis of REA. This is true because of the price difference of the Choice-Select spread and the fact that there is very little incentive to produce cattle better than a Yield Grade 3. This index is geared to service any commercial program that has British-cross cows.

Calving Ease Index (CEZ$)
This is a general purpose index that focuses on identifying bulls that can be used on heifers and then ultimately the calves will be marketed through the CHB program. As you might expect, CE and MCE carry significant weight in this index along with fertility. There is very little weight put on growth traits and less emphasis on carcass. Remember, this is a general index that is specifically designed to be used in a heifer program.

Brahman Influence Index (BII$)
BII$ is a maternally focused index that is based on a 1,000-head cow herd of Brahman x Hereford cows. The progeny for this index will be harvested in a commodity-based system since CHB does not accept Brahman-influenced cattle into the program. This index has less emphasis for CE than any of the other indexes. There is emphasis on both REA and IMF since the cattle will be harvested through a commodity market. The largest emphasis is in fertility, which is measured solely by SC at the present time. Obviously, the target for this index is the producers in the Southern regions of the U.S. where the bulls are typically sold to commercial cattlemen that have Brahman-influenced cow herds.

Certified Hereford Beef Index (CHB$)
This is a terminal sire index that is built on a production system where Hereford bulls sire calves for the CHB market. There is some pressure put on CE and then positive weight on both WW and YW. Remember that all offspring in this index are harvested, so they need to be born alive and then grow fast at all stages of life. Of course, we have much more emphasis on fat in this index, as we want the cattle to stay lean. There is also a significant weight on both REA and IMF with more emphasis again on IMF. This index would be used by producers who have a target of producing bulls for a terminal breeding program. It could be used heavily in the Midwest where bulls are used in rotational breeding programs to produce cattle in a retained ownership program or are simply sold to backgrounders. This is the only index that has no emphasis on fertility. Remember that nothing is retained in the herd. **HW**