BIG PIG DATA IS CHANGING THE INDUSTRY

Insights from inside

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It's a new scenario for pig production because of two major factors, African Swine Fever (ASF) and Covid-19. Market prices are volatile, knowing how global prices will evolve will not be easy to predict.

What is sure is that every pig producer must now do everything they can to stay competitive, this will be a combination of efficiency (in reproduction, as many piglets per sow per year as possible) and quality (healthy, homogeneous and of good weight). To accomplish efficiency and quality, swine farmers must rely on data and its proper use.

The value hidden in massive data is enormous and can improve performance of our farms, supporting better decision making from daily details to medium-long term strategic decisions. What has the Pro Europa group accomplished by scrutinizing the data? Defining what matters most, quantifying it and prioritizing it.

Pro Europa group working together with Prof. Koketsu (Meiji U) have published 14 peer-reviewed papers in the last five years about the most critical factors that affect reproduction performance by analyzing large databases merged from customers' data. This allowed us to characterize and update a number of factors affecting large operation reproduction, including:

- The impact of factors for improving reproductive performance of sows and herd productivity in commercial breeding herds
- The risk factors for severe repeat-breeders and their lifetime performance
- What determines that a farm is high-performing
- The best age for first mating based on herd factors
- Mortality and survival probability of sows based on season and parity
- Abortion occurrence and risk factors
- Behavior in electronic sow-feeding systems, repeatability and associated factors
- Lifetime performance prediction based on P1 and subsequent WTEI, among others

More analytics by combining reproduction with other data sources like lactation feeders, weather and environment or health will be reviewed in the future.

Are these just nice peer-reviewed papers disconnected from reality? Are they too academic? No because all of them come from our daily work and give insights into what individual operations can see, despite their size. These great insights support decision-making for producers and vets through a better understanding of pain points, their early correction, focused training and risks decreased in production planning. We can't afford to skip regular, systematic and intelligent use of the data we generate-- information and data are another asset of the farm. You must always try to generate more benefits with your assets.

Great insights support decision-making for producers and vets through a better understanding of pain points, their early correction, focused training and risks decreased in production planning.

Also, be aware of how your neighbors are doing (including your global neighbors), look at benchmarking and prioritizing those areas of greatest impact on your farm. Intelligent benchmarking is a handy tool to structure your upcoming actions to keep your performance as you expect, and it starts with knowing with whom to compare. The selection of peer groups is crucial to insightful benchmarking. It's fine to know your global position for a particular KPI, but wouldn't it be more interesting if you can add some fine-tuned comparison of your preferences, including factors that you know are very relevant? Here are some examples:

- **Breed.** All the breeds can be good depending on your market, your situation, your purpose, but they could be very different. If breed is not included in your benchmarking it can sometimes confuse your understanding of what is actually going on. For Example:
  - Hyper prolific sows show an astounding number of total born, but frequently have a higher number of stillborn and pre-weaning mortality.
  - Longevity, mortality, pre-weaning mortality and culling rate can be very different between breeds.

- Piglets weaned in a lifetime.

Pro Europa never recommends public comparison among breeds, since this can lead to unnecessary misunderstandings, better to be done in closed environments (i.e intracompany or intracustomers).

- **Health.** It is a relevant factor affecting reproductive performance, but it is not easy to benchmark. Including PRRS, Influenza or other relevant diseases positive or negative in the selected benchmarking period, can help to understand your performance in the context of the disease. This is much easier to do in closed environments (i.e. intra-company) but of high value, if achieved.
- **Management.** Specific management procedures can influence primarily reproductive performance, including :
  - Stalls or group sows
  - Purchase of gilts or F1 raised at the farm
  - Batch management (2, 3, 4 or 5 weeks)
  - Farm flow (FtF, FtW, FtN). These are in general easy and straight forward and of great value when making decisions.
- **Nutrition and nutrition management.** Nutritional profile and management when properly standardized can offer great insights into relevant factors. Benchmarking of feeding programs include:
  - Pre and post farrowing feeds
  - Lactation feeders and which to utilize (they are not all the same). It is an area of research that is growing and will provide you with solid strategies for the future.

Finally, it must be noted that every information system, if well designed, should address four levels of information delivery at the same time:

1. **Alerts.** Something over or under a predefined threshold. Generally, present and easily understood by farm staff.
2. **Monitoring.** What's going on, preferably under certain limits, generally well used.
3. **Analytics (explanatory).** Use existing data to explain what happened and correct for the future.
4. **Analytics (predictive).** Use existing data to predict what is likely to happen.

These last (predictive analytics) are useful and proven statistical techniques to use stored data. Once a factor is known, and if you like it, just continue what you are doing. If you do not like the results, change your working protocols. As a practical example, early last year Pro Europa published its predictions for Spanish reproductive performance, confirming later that our prediction was 99% accurate for the main KPI. Most interesting was that certain insights were particularly relevant. Why? Because some of the factors depended on farms structure, large farms were improving where family farms kept stable or worsened and *vice versa*. This leads to different strategies to keep performance depending on every operation.

Take-home messages:

- Put your data at work and listen to the story it tells
- Make better and funded decisions at every level (daily – strategical)
- Improve first your farm and secondly your market position by smart benchmarking
- Get more peace of mind and improve your business

Data is your loyal ally, work together using knowledge from your data.

SPANISH VS UNITED STATES FARMS; COMPARING TWO PRODUCTIVE MODELS

Spain and USA are two major countries in the global pig production industry and are both efficient reference models. To understand some of their differences regarding reproduction, we have compared a total of 627 farms (262 from Spain and 365 from the USA) for a total of 1.088.486 productive sows in 2019. These farms are PigCHAMP customers that receive support and contribute to anonymous benchmarking, both for their own and general benefit, looking for improvement based on the intelligent use of their data. We can't say if they are representative or not of the productive system in every country, but it is a good overlook, taking into account the number and diversity of farms included.

To be able to compare both the results for the means and the standard deviation for every variable the following tests were used: Kolmogorov-Smirnoff test for normality, Levene test for the homogeneity of the variances and Kruskal-Wallis for the means, using NPAR1WAY of SAS. Therefore, PMean shows if there is a significant difference comparing the means and PSD, then there is a significant difference in the homogeneity of every mean.

Results are presented in Table 1 (page 8).

DISCUSSION

This analysis shows the difference between the two productive models. In the United States, the tendency is

Table 1. Means for the main reproductive variables between USA and Spanish farms in 2019

	Spain		USA		P<f	
	Mean	SD	Mean	SD	P_{Mean}	P_{SD}
Percent Gilt First Services	19.82	*0.489*	22.06	*0.413*	**<.0001**	**0.0002**
Av Wean To 1st Service Interval	6.41	*0.171*	7.46	*0.144*	**<.0001**	0.1047
Percent Weaned Sows First Served By 7Days	88.67	*0.506*	87.36	*0.428*	0.0574	0.0875
Percent Repeat Services	9.55	*0.284*	6.21	*0.240*	**<.0001**	0.6928
Conception Rate	85.02	*0.340*	85.95	*0.287*	**0.0170**	0.9264
Liveborn Less Than 7 As Percent Of Farrowings	4.75	*0.180*	5.08	*0.152*	0.0632	0.7692
Farrowing rate	83.21	*0.368*	84.09	*0.311*	**0.0394**	0.9300
Total Born Per Litter	15.17	*0.085*	14.70	*0.072*	0.0631	**<.0001**
Liveborn As Percent Of Total Born	90.14	*0.172*	89.79	*0.146*	**0.0232**	0.5527
Stillborn As Percent Of Total Born	8.11	*0.144*	7.66	*0.122*	**0.0489**	0.3304
Mummified As Percent OfT otal Born	1.753	*0.097*	2.543	*0.082*	**<.0001**	0.4381
Farrowing Index	2.416	*0.020*	2.546	*0.016*	**<.0001**	**0.0148**
Farrowing Interval	151.29	*0.635*	145.46	*0.537*	**<.0001**	**0.0044**
Av Gestation Length	115.58	*0.047*	115.90	*0.040*	**<.0001**	0.5290
Liveborn Per FemalePer Year	29.34	*0.300*	29.74	*0.253*	0.3731	0.2335
Total Piglet Losses As Percent Liveborn	8.96	*0.366*	11.17	*0.310*	**<.0001**	**0.0176**
Piglet Age At Loss	5.85	*0.293*	3.70	*0.249*	**0.0048**	0.7931
Piglet Losses Less Than 2 Days As Percent Liveborn	3.71	*0.206*	4.92	*0.174*	**<.0001**	0.4448
Piglet Losses 2 To 8 Days As Percent Liveborn	2.85	*0.159*	4.26	*0.134*	**<.0001**	**<.0001**
Piglet Losses Over 8 Days As Percent Liveborn	2.40	*0.138*	1.99	*0.117*	0.3820	0.3875
Pre Weaning Mortality	13.16	*0.239*	14.55	*0.202*	**<.0001**	**0.0004**
Weaned Per Litter	11.92	*0.059*	11.48	*0.050*	**<.0001**	**0.0069**
Weaned Per Sow	11.83	*0.066*	11.26	*0.056*	**<.0001**	0.5365
Piglet Age At Weaning	25.11	*0.156*	20.82	*0.132*	**<.0001**	0.6140
Lactation Length	25.16	*0.150*	20.65	*0.127*	**<.0001**	0.7355
Weaned Per Female Per Year	25.40	*0.227*	24.86	*0.192*	0.2579	**0.0028**
Replacement Rate	46.8	*0.0151*	62.0	*0.0128*	**<.0001**	0.2524
Percent Female Deaths Per Year	9.5	*0.0040*	12.3	*0.0033*	**<.0001**	0.2737
Av Parity Sows Died	2.95	*0.063*	3.00	*0.054*	0.5903	0.1340
Percent Female Sales Per Year	40.3	*0.0300*	47.8	*0.0253*	**<.0001**	0.1628
Av Parity Sows Sold	4.76	*0.089*	4.19	*0.076*	**<.0001**	**<.0001**
Sow Non Prod Days Per Sow Per Year	40.90	*0.973*	49.06	*0.8225*	**<.0001**	**0.0204**
Female Non Prod Days Per Sow Per Year	64.53	*1.662*	67.71	*1.405*	**0.0116**	**0.0395**
Weaned Per Sow Per Year	26.93	*0.223*	26.08	*0.189*	**0.0127**	0.9616

to achieve the maximum possible production rate of the sows, reducing the duration of lactation (20.65 days). In comparison, in Spain this duration is considerably longer (25.16 days), also influenced by legislative restrictions. As a result, the interval between farrowing is shorter (145.46 days vs 151.29) and the average number of farrows per sow per year is higher in the United States farms (2,546 vs 2,416).

Farrowing rate is better in United Sates farms by almost 1 point (0.88 %, 83.21% vs 84.09%), but interestingly, the non-productive days per sow and year are much higher on farms in the United States (8.16 d, 49.06 d vs 40.90 d). Not only do the wean-to-estrus interval contribute to this (longer in the U.S., 7.46 days vs 6.41 days, probably affected by shorter lactation periods), but there are probably more late reproductive failures in the United States farms. In fact, in the United States farms there is a lower percent of repetitions (6.21% vs 9.55%), and therefore there are probably more reproductive failures of other types (sales, deaths or not-in-pig sows) that accumulate more non-productive days.

In maternity, in Spanish farms more hyper prolific breeds are used, so the averages at birth (total born 15.17 vs 14.70, born alive) are higher. Moreover, this higher performance is transferred to farrowing until weaning (11.26 weaned per sow in the United States, 11.83 in Spanish farms), since preweaning mortality

is even lower in Spain (14.55% vs 13.16%) despite the higher prolificacy.

Therefore, despite the higher production rate (farrowing per sow per year) in the United States farms, the higher number of non-productive days and the lower weaning performance lead to almost 1 pig less weaned per sow per year (26.93 vs 26.08).

Therefore, data shows that higher reproduction rates do not always influence sows' mortality and sales rates, because the annual sow replacement rate is higher in the United States farms (62% vs 46.8%).

Both models are useful and successful but understanding how each number is derived can lead to better decision-making, risk control and customized decisions for each of our farms.

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Carlos Piñeiro, DVM, MS, PhD. CEO of PigCHAMP Pro Europa. Dedicated to the establishment of information systems and the digitalization of livestock businesses; big data and predictive analytics, including the integration of different sources of data; farms biosecurity real-time control; applied research under commercial conditions (testing of products, systems and equipment); education and data-driven training.

Table 2. Range, top and worst 10 and median for the main reproductive variables between USA and Spanish farms in 2019

	Spain					USA				
	Max	P. 90	Median	P. 10	Min	Max	P. 90	Median	P. 10	Min
Percent Gilt First Services	55.50	24.71	19.10	15.18	0.00	68.99	30.43	22.40	12.05	0.00
Av Wean To 1st Service Interval	17.00	8.08	5.97	5.02	3.86	46.12	9.98	6.76	5.19	3.95
Percent Weaned Sows First Served By 7 Days	8.81	94.72	90.48	80.20	39.90	99.91	96.29	89.51	76.87	29.24
Percent Repeat Services	28.53	15.34	9.13	4.49	1.96	28.48	12.20	5.79	1.19	0.00
Conception Rate	95.24	91.06	86.03	78.22	58.16	98.43	91.72	86.56	79.73	55.95
Liveborn Less Than 7 As Percent Of Farrowings	29.09	7.25	4.35	2.07	0.37	34.34	8.09	4.64	2.53	0.11
Total Born Per Litter	19.98	17.85	14.77	13.46	8.41	17.22	16.00	14.82	13.43	9.02
Liveborn As Percent Of Total Born	96.60	93.44	90.32	86.66	76.65	99.28	92.93	90.03	86.49	81.25
Stillborn As Percent Of Total Born	21.87	11.00	7.76	5.36	3.18	15.61	10.55	7.40	5.05	0.73
Mummified As Percent OfT otal Born	10.76	3.52	1.48	0.00	0.00	10.03	4.04	2.48	0.85	0.00
Farrowing Index	2.56	2.50	2.42	2.33	2.09	5.65	2.58	2.50	2.37	2.00
Farrowing Interval	174.92	156.83	150.75	146.40	142.62	182.32	153.91	146.03	141.72	64.63
Av Gestation Length	119.20	116.55	115.55	114.64	113.35	121.28	116.68	115.92	115.01	112.90
Liveborn Per FemalePer Year	41.37	35.42	28.89	24.75	13.71	62.92	33.88	29.53	24.76	11.34
Total Piglet Losses As Percent Liveborn	20.31	15.86	9.90	0.00	0.00	26.48	18.06	12.32	0.00	0.00
Piglet Age At Loss	32.71	12.98	4.51	0.00	0.00	10.56	6.15	3.88	0.00	0.00
Piglet Losses Less Than 2 Days As Percent Liveborn	17.41	8.14	3.56	0.00	0.00	16.73	8.65	5.36	0.00	0.00
Piglet Losses 2 To 8 Days As Percent Liveborn	9.59	6.07	2.89	0.00	0.00	13.53	7.30	4.58	0.00	0.00
Piglet Losses Over 8 Days As Percent Liveborn	15.92	4.64	1.64	0.00	0.00	7.58	3.99	1.94	0.00	0.00
Pre Weaning Mortality	25.56	18.39	12.93	8.25	3.54	27.19	19.55	14.16	10.40	4.53
Weaned Per Litter	15.17	13.33	11.76	10.69	6.94	13.80	12.36	11.56	10.66	6.85
Weaned Per Sow	15.19	13.51	11.64	10.41	6.83	13.61	12.42	11.31	10.21	5.50
Piglet Age At Weaning	34.42	27.99	25.23	21.65	19.39	37.13	23.25	20.36	18.77	14.93
Lactation Length	32.12	28.09	25.35	21.99	19.67	36.02	23.15	20.22	18.57	14.59
Weaned Per Female Per Year	34.87	30.52	25.18	21.33	11.30	36.79	28.84	25.21	20.35	7.87
Replacement Rate	141	60	45	34	0	227	79	57	40	0
Percent Female Deaths Per Year	134	14	8	5	0	25	18	12	7	0
Av Parity Sows Died	5.30	4.08	2.93	2.00	0.00	8.89	4.30	2.87	1.87	0.00
Percent Female Sales Per Year	11.57	0.49	0.36	0.25	0.00	2.04	0.68	0.46	0.27	0.00
Av Parity Sows Sold	7.96	6.09	4.81	3.48	0.00	13.87	5.76	4.07	2.53	0.05
Sow Non Prod Days Per Sow Per Year	122.33	55.61	38.25	27.61	18.78	199.97	66.88	46.09	32.48	18.59
Female Non Prod Days Per Sow Per Year	226.31	95.36	59.38	35.97	21.27	220.08	98.08	63.75	41.34	22.87
Weaned Per Sow Per Year	36.65	31.33	26.63	22.89	13.22	43.59	30.10	26.40	21.90	8.73