# Gilt Development: The Foundation for Improved Sow Lifetime Productivity

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Management of the breeding herd is fundamental to achieving profitable pig production. Careful planning and monitoring of some of the key aspects can help transform the performance of your business. This begins with the gilt starting from birth.

Effective gilt management practices lay the foundation for future performance and are critical to improving sow lifetime productivity (SLP). Improved SLP represents a significant opportunity for the industry as it drives better reproductive performance and improved productivity. A focus on the gilt leads to a better parity structure that positively impacts herd health, grow-finish performance of offspring and overall improvements in profitability, sustainability and sow welfare.

The importance of SLP is shown by the challenge of annual sow culling rates that historically ranged between 40-50% (Engblom et al., 2016), but recent industry data indicates high variability between herds (PigChamp, 2025). Many sows are culled prior to their third parity, which is before a positive return on investment can be achieved (Stalder et al., 2003). Recent analysis of industry data consisting of more than 1,000,000 gilts from the PigCHAMP North America database (Patterson and Canavate, 2023) reported that of gilts originally served, 8 to 10% never farrowed a litter, 14 to 19% were removed between parity 1 and parity 2 and only about 30% remain in the herd after six parities.

This loss of early parity females remains one of the biggest challenges for the industry. The loss between parity 1 and parity 2, represents the greatest opportunity. Although, mortality continues to be a challenge (28% of these losses are due to death), culling for failure to farrow (did not conceive, returns, negative pregnancy checks, and abortion), no heat after weaning, lameness and productivity are the largest contributors to losses between parity 1 and parity 2 (Patterson and Canavate, 2023).

In this paper, we will review the key principles for improved SLP that address the challenges described above. The implementation of sound evidence-based gilt management practices will improve SLP and ultimately the overall efficiency of replacement gilt production and the genetic transfer program within the Canadian pork industry.

Focusing on the following management practices from birth onward will positively impact SLP:

1. Selection and management practices at birth and weaning
2. Selection of gilts before entering the final selection phase
3. Implementing effective Gilt Development Unit (GDU) management practices
4. The Key Components for Gilt Eligibility and the “Fertility Quadrant”
5. Expanding gilt development to include “Parity 1 Development”

## 1. Selection and Management Practices at Birth and Weaning

The selection and management of gilts start at birth and there are several important “litter of origin” traits that impact SLP:

- **Low individual birth weight (<1.0 kg):** Negatively affects piglet mortality, survival, and growth rate and has been shown to delay puberty, reduces piglet production and sow longevity (Patterson et al., 2020).
- **Colostrum intake:** Plays a vital role in promoting pig health, growth rate and survivability (Faccin et al., 2022).
- **Nursing litter size:** Strategic cross fostering of replacement females, reducing the size of the lactation litter, has been shown to have positive effects on overall retention rates, farrowing rates and pigs born alive (Flowers, 2022).
- **Pre-weaning growth and weaning weight**: Pre-weaning growth rate is associated with early age at puberty (Vallet et al., 2016) and positively associated with the proportion of sows that farrowed two litters and the total number of pigs produced over 4 parities (Knauer, 2016)
- **Weaning age:** Increasing weaning age by 3 days represents an increase of 0.5 pigs per sow per year (Knauer, 2016). Depending on your individual farm, it may be important to consider a wean age of 24 days for replacement females (Faccin et al., 2022).

## 2. Selection of Gilts Before Entering the Final Selection Phase

To start off with the best females, increase selection intensity by assessing the quality and quantity of gilts prior to entering the final selection phase (Weger, 2024).

Classify gilts as either:

- **Gilts to be culled:** Gilts not achieving a growth rate of 0.6 kg/d at ~140 days of age, or those with poor health, inadequate number of teats, poor vulva score, any defects or are unthrifty, should not be permitted to enter the final selection or
- **“Pre-Select” gilts:** Identify and select gilts based on their positive phenotypic traits such as structure, conformation and locomotion. This represents an opportunity to improve sow retention and productivity.

Always plan ahead – Recognize potential housing, environmental and management limitations to tailor the gilt flow to meet your needs.

## 3. Implementing effective Gilt Development Unit (GDU) management practices

A well-managed GDU system is key to identifying gilts with the highest reproductive potential (Patterson and Foxcroft, 2019).

- **Design efficient puberty stimulation and heat detection protocols that maximize exposure to the “boar effect”:** An early pubertal response (a measure of sexual precocity) is linked to better SLP and is the key driver in achieving the targets for age, weight and heat-no-serve events (HNS) at 1st mating (see below). Direct contact is more effective than fenceline contact for maximizing the gilt’s response to the boar.
- **Boar management:** A consistent supply of mature (older than 10 months), high libido (sexually motivated), size appropriate, mobile (an uncompromised ability to stand and walk) epididimectomized or vasectomized boars (teaser boars) is an essential, and often under recognized, component of the GDU.
- **Allocate necessary resources to the GDU**: Invest in the development and skills of the lead stockperson and provide the necessary tools to your team for them to be successful.

## 4. The Key Components for Gilt Eligibility and the "Fertility Quadrant"

There are four key component traits for gilt eligibility at first mating that are commonly accepted in the industry. While these components can be discussed individually, they are not independent of each other. Rather, they interact with each other to influence a gilt's future productivity and retention. Developed in collaboration with Dr. Sergio Canavate from PIC NA, the "Fertility Quadrant" is a concept that integrates the four gilt eligibility traits of gilt development.

**The Four Key Components for Gilt Eligibility:**

Note that there be may slight differences in these recommendations between genetic suppliers, it is important to consult with your specific advisors for their guidance.

- **Early puberty:** An early pubertal response (a measure of sexual precocity) is linked to better SLP and is one of the first indicators of future performance. Gilts with early puberty have improved retention rate and longevity, produce more litters and piglets during their lifetime and accumulate fewer non-productive days (Faccin et al., 2022, Patterson and Foxcroft, 2019, Tart et al., 2013). Gilts should be stimulated early enough (~160-170 days of age) to trigger early puberty to permit producers enough time to breed gilts at second estrus and at acceptable target weights. A key metric to track this is the percentage of gilts with a recorded heat by 190 days of age.
- **Estrus at service:** Delaying breeding to second detected estrus is known as *"Heat-No-Serve"* (HNS) and is an accepted practice in the industry. Breeding gilts with a HNS has long been associated with a positive effect on first litter size and gilts bred at second estrus produced 1.3 more pigs after four litters compared to gilts bred at first estrus (reviewed by Levis 2000). More recently, gilts bred at first detected estrus were reported to have lower lifetime efficiency as measured by retention and total pigs born per gilt served than those bred with a HNS (Pinilla & Patterson, unpublished data, 2020). This confirms that a HNS not only has impacts on first litter size, but has lasting long-term performance benefits.
- **Service weight:** While a positive correlation between service weight and first litter size exists, there is a tradeoff between first litter size and long-term retention. Increased service weight has been associated with heavier weights at farrowing, increased nutritional demands during lactation and over their productive life, locomotion problems over three parities, and a higher occurrence of stillbirths that may be associated with farrowing difficulties (reviewed by Bortolozzo et al., 2023). All of these will have a negative effect on sow welfare (Diaz et al., 2025). The recommended weight at service varies between genetic supplier, typically ranging from 140 to 170 kg. These targets are designed to ensure that gilts enter the farrowing unit with the ideal weight and condition to support performance in the first lactation.
- **Service age:** An increased service age has been associated with an increase in first litter size (Koketsu et al., 2020). However, again there is a trade-off. Gilts with early age at first mating are more likely to become higher efficiency sows as measured by increased herd-life days and annualized piglets weaned and reduced non-productive days (Koketsu et al., 2020). Conversely, older gilts are likely to be overweight and less productive over their lifetime. It is important to distinguish the difference between chronological age (days from birth) versus physiological age (maturity). Physiological age is the better metric because it takes into account the physiological state of the gilt in terms of both estrus and weight at service.

**The "Fertility Quadrant"**

The "Fertility Quadrant" concept is about achieving the optimal balance between the four individual traits discussed above. The simplified concept of the "Fertility Quadrant" is shown in Figure 1, and demonstrates how the individual component traits for age and weight (Yes or No) and HNS (Yes or No) interact to determine a gilt's physiological state at first service.

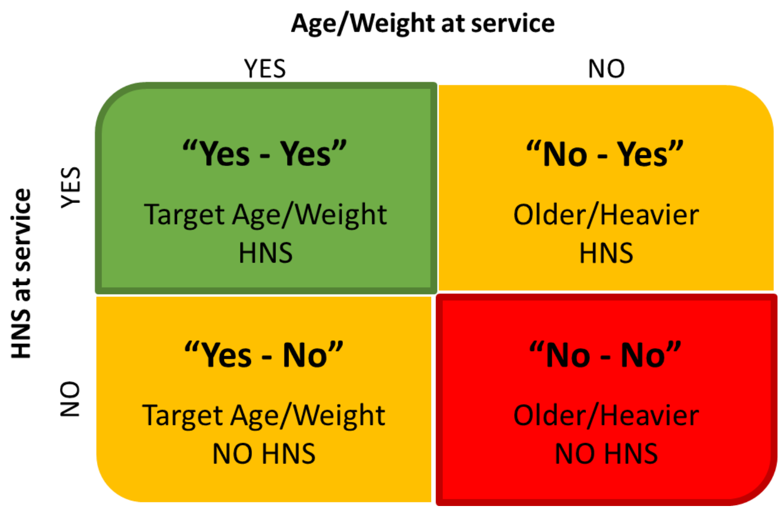


**Figure 1.** Simplified concept illustrating the key gilt eligibility components of the "Fertility Quadrant". The "Target Quadrant" (Green) shows gilts bred meeting the targets for age, weight and HNS, while the "High-Risk" group (Red) indicate those gilts meeting none of the targets. The intermediate categories (Yellow) show gilts where one or two traits may be missed.

Optimal performance would be predicted when a gilt is bred to meet the targets for weight, age and HNS (Yes, Yes). In contrast, the high-risk group would be gilts bred achieving none of the targets (No, No). Gilts falling into intermediate categories, where one or more traits may be missed, will have intermediate performance results.

Given the day to day challenges and the realities of meeting breeding targets in any given farm and production system, it is important to understand the tradeoffs when one or more benchmarks are not met. The concept also encourages producers to shift the focus from short term results, such as first litter size, toward a broader outcome of long-term productivity and retention over the lifetime of a female.

**Science into practice: What does industry data tell us?**

In a recent analysis of industry data from over 60,000 gilts from a US Midwest production system (PIC, 2025), we first looked at an individual component analysis for age and HNS (weight was not recorded).

The results confirm what we expected – the individual components lay the foundation of sow lifetime productivity and they do not function independently of one another.

- **First parity litter size**: HNS at breeding resulted in a modest, but significant increase in total born (+0.3). Additionally, gilts bred greater than 240 days had a higher first litter size (+0.5) than gilts bred between 180-200 days.
- **Early parity loss:** Loss between parity (P) 1 and 2 progressively increases with age at first service, gilts served >240 days had a P1 to P2 loss of 21% compared to 14.7% for gilts served at 180-220 days of age. A HNS at first breeding had a positive effect, with a loss of 15.7% compared to 18.2% for gilts bred at their first detected estrus. Culling for reproductive reasons (no heat after weaning, return to estrus, fail to farrow) and lameness are the primary driving factors, and not mortality.
- **Retention to parity 3:** A significant interaction exists between age at service and HNS for retention to parity 3 (Figure 2). As chronological age increases, there is decrease in retention to parity 3. However, a HNS was shown to have a protective effect, minimizing the decrease in retention after 220 days of age. This confirms that while older gilts are at risk for earlier removal from the herd, the implementation of a HNS program, is an important management tool to improve sow longevity.
- **Productivity to parity 3:** There was also a significant interaction between age at service and HNS for productivity as measured by pigs produced over 3 parities (Figure 3). Similarly, as chronological age increases, there is a decrease in productivity and a HNS has a protective effect for gilts bred after 240 days of age. Again, this confirms the implementation of a HNS program is a critical in setting up gilts for improved productivity, the second key component of SLP.

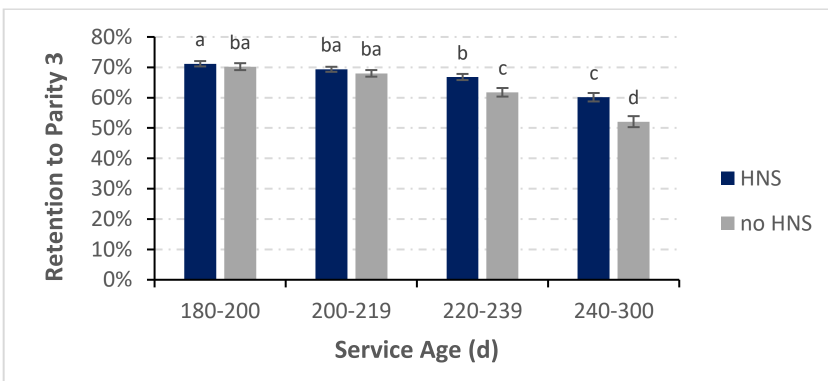


**Figure 2.** Retention rate of gilts to parity 3 based on the interaction between age at first service and the presence of a HNS. Blue bars represent gilts with a recorded HNS, grey bars represent gilts with no HNS. Different superscripts indicate significance (P < 0.05).

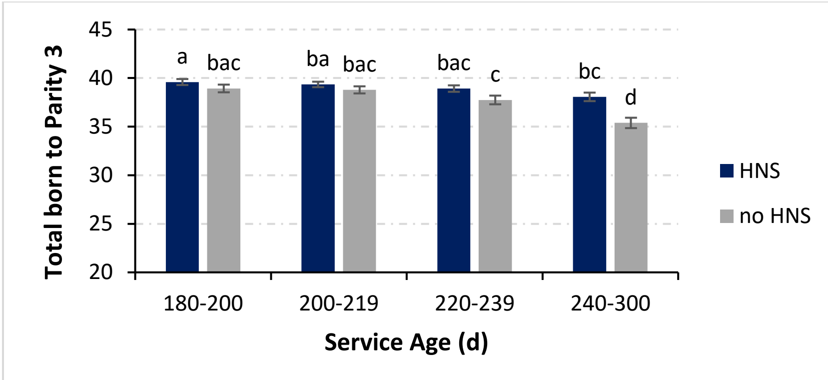


**Figure 3.** Total pigs born to parity 3 based on the interaction between age at first service and the presence of a HNS. Blue bars represent gilts with a recorded HNS, grey bars represent gilts with no HNS. Different superscripts indicate significance (P < 0.05).

These results support what we discussed above – we need to go beyond an individual component analysis and explore the "Fertility Quadrant". It is important to remember that these component traits do not function independently, their interaction determines the gilt's physiological state at service. This is underlined by a second analysis.

Gilts were then grouped broadly based on the results of the individual component analysis for service age (180 to 219 or 220 to 300 d) and HNS (Yes or No) at breeding. The results in Table 1 confirm that breeding gilts to meet the key targets for both age and HNS leads to optimal retention and productivity through third parity, while minimizing the loss between parity 1 and 2. Conversely, when neither targets are achieved, sow lifetime productivity (SLP), as measured by retention to parity 3 was 13.6% lower, and the number of pigs weaned to parity 3 was 5.8% lower. In situations where the service age or HNS targets were missed the results were intermediate.

**Table 1.** Retention and Weaned Pig Productivity to Parity 3 Based on Gilt Age and Heat-no-Service (HNS) at First Breeding.

| Fertility Quadrant | Age Range: 180-219d HNS: Yes **"Yes – Yes"** | Age Range: 180-219d HNS: No **"Yes – No"** | Age Range: 220-300d HNS: Yes **"No – Yes"** | Age Range: 220-300d HNS: No **"No – No"** | *P-Value* |
|---|---|---|---|---|---|
| % Gilts bred/group | 38.4% | 23.5% | 20.8% | 17.2% | - |
| **Retention** | | | | | |
| Retention to P1 | 95.1 ± 0.3[a] | 94.4 ± 0.3[b] | 93.7 ± 0.3[b] | 92.3 ± 0.4[c] | <.0001 |
| Retention to P2 | 80.7 ± 0.6[a] | 78.1 ± 0.7[b] | 76.3 ± 0.7[c] | 73.1 ± 0.8[d] | <.0001 |
| Retention to P3 | 69.8 ± 0.7[a] | 66.7 ± 0.8[b] | 64.6 ± 0.8[c] | 60.3 ± 0.9[d] | <.0001 |
| **Productivity** | | | | | |
| # Weaned pigs to P3 | 32.8 ± 0.3[a] | 32.1 ± 0.3[b] | 31.9 ± 0.3[b] | 30.9 ± 0.3[c] | <.0001 |
| **Fertility Index**[†] | 2289 | 2141 | 2061 | 1863 | - |

Different superscripts within a row indicate significance (P < 0.05).

[†]Fertility Index = (100 gilts bred) x (Retention rate to P3) x (# of pigs weaned to P3)

To put this into perspective, when we estimate a “Fertility Index”, the high-risk “No-No” group would wean 426 fewer pigs over 3 parities per 100 gilts bred than the optimal “Yes-Yes” group. This highlights the potential economic value of breeding gilts in the optimal “Fertility Quadrant”.

These results provide clear evidence of gilts as the foundation of future performance. The priority should be to breed more gilts “in the sweet spot” (the “Yes-Yes” group in Figure 1) to meet the recommendations for age, HNS and weight. As always, tailor these guidelines to meet your individual genetic company’s recommendations.

It is important to understand the tradeoffs when targets are missed and to empower the farm level team to make the right breeding decisions. Data management is critical; monitor GDU performance with key production indicators to make data driven decisions. We must “put the GDU to work” and recognize that early puberty is the critical driver and ensure gilts are managed to consistently achieve these targets to fully realize the genetic potential of the females available to the industry.

### 5. Gilt development does not stop at first mating – Focus on Parity 1 Development

Gilt development should extend beyond first breeding to ensure the "right" gilts are delivered to the farrowing room. To improve SLP, focus on:

- **Feed management during gestation:** Ensure gilts maintain or build body reserves without becoming over-conditioned at farrowing.
- **Body condition at farrowing:** Proper body condition impacts farrowing success, colostrum production, milk yield, and lactation performance.
- **Management during first lactation**: Provide individualized care to primiparous gilts and their litters during lactation.
- **Post-weaning management:** Address issues like failure to conceive, no heat, and lameness to reduce losses between parity 1 and 2.

### Conclusion

This paper highlights that effective gilt management from birth through parity 1 is crucial for improving sow lifetime productivity (SLP). By focusing on key practices such as early selection, efficient GDU management, ensuring proper gilt eligibility at first mating, and improving parity 1 development, farms can improve SLP and reduce the genotype-phenotype gap. Supporting the translation of science into practice is critical to driving better sow retention, productivity, and overall farm efficiency.

### Disclosures

This manuscript builds on several earlier articles and presentations by the author, as referenced throughout the text. In particular, it draws from material previously presented at the 2025 Banff Pork Seminar and 2025 Ontario Swine Conference.

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