The Application of Improved Gilt Pool Management: An Industry Perspective

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The gilt pool is the fuel for the breeding farm. Without sufficient gilts, service targets cannot be achieved and weaned pig volume falls correspondingly. The gilt pool also has significant effects on the efficiency of breeding herd performance. There are more gilts being bred and farrowed than any other parity. Thus, when gilt litter sizes and farrowing rates are high, herd performance typically is competitive. This paper focuses on how to set up the gilt pool in a multi-farm system to optimize farm throughput (i.e. number of weaned pigs/unit time) as well as to improve the efficiency by which the breeding herd produces weaned pigs (i.e. pigs weaned/sow/year).

▪ Impact of the Gilt on the Herd

Herd Productivity

Efficiency of Production

The effects of parity on endpoints of breeding herd productivity have been long understood. With most genetic lines, both born-alive and total-born litter size rise as parity increases up to 3rd to 5th parities, prior to falling as parity increases beyond the 6th parity. Similarly, fertility, as shown by pregnancy check positive (PCP) rates, post-ultrasound fall-out rates, and farrowing rates, is lower in younger as well as older parities relative to mid-parities. Measures of perinatal mortality, which include both stillbirth and preweaning death rates, increase in a near-linear fashion with advancing parity as long as the sow remains in the herd.

Gilts constitute the largest parity group in most herds, often being 25% or more of all the females in a herd. Consequently, they have the greatest effect on overall herd productivity of any parity group. When gilts perform well, the herd

has a high level of efficiency; conversely, when they do poorly, the herd often fails to achieve industry standards of performance.

Throughput

The output of a breeding herd is most commonly measured in terms of the number of pigs weaned per unit time, typically pigs weaned/week. Weaned-pig output can be measured as an absolute number or as a percentage of a budgeted value. Along with weaned-pig cost, weaned-pig output is one of the most common measurements of breeding herd throughput. Weaned-pig output is driven by weaned-litter size (i.e. number of pigs weaned/litter weaned) and the number of litters weaned per unit time. In turn, litters weaned/week is driven largely by number of females served/week.

The number of females served into a breeding group is dependent upon the size of four subpopulations in the herd:

- Weaned sows
- Opportunity sows
- Females that return to estrus following mating (recycles)
- Gilts in the available pool

The opportunity sow pool is comprised of sows that have not returned to heat within seven days, called Late Weaners (LW), sows that have been weaned prior to 14 days of lactation, called Early Weaners (EW), sows that have aborted (ABORT), females that have been found to be negative by ultrasound tests of pregnancy or visual examination for pregnancy (pregnancy check negative, PCN), and females available to be bred if needed but otherwise destined to be culled, called Active Culls (AC). As shown below, the steps that must be taken to achieve breeding targets are highly dependent upon the gilt subpopulation.

1st Calculate the budgeted number of farrowings/week.

Calculating the budgeted weekly farrowings is necessary in order to achieve the desired utilization of farrowing facilities, and to determine the farrowing group size and “flow” of females through the farm. Budgeted farrowings should consider the percentage of farrowing sows that are early and zero weaned. Key factors influencing budgeted farrowings include:

- Stage of gestation that females are loaded into farrowing.
- Desired lactation length.
- Number of rooms to farrow each week.

Targets for number of farrowings/week are greater than *budgeted* numbers and are usually determined by having females loaded into farrowing at a later gestation date, having them weaned at a shorter lactation length, and by farrowing more rooms of sows weekly.

2nd Do a "gilt needs projections" for the farm.

Gilt needs projection computations are necessary so that sufficient gilts are available to meet service targets throughout the year. Establishing the gilt needs for a farm is dependent upon the budgeted replacement rate for the herd, the seasonal change in farrowing rates, and the number of females that have already been served into existing service groups (i.e. the size of holes in breeding groups that must be filled). Note, because PCP and post ultrasound fallout rates fall when females are mated during the summer, more females have to be mated. Until the sizes of recycle and opportunity sow pools increase in response to the seasonal drop in fertility, the sow herd inventory must be grown by increasing the size of the gilt pool, if service targets are to be achieved.

3rd Set up the gilt development system.

The "flow" of gilts through the gilt development system must be established to ensure that the changing needs for gilts are met throughout the year while achieving:

- the budgeted age at first service,
- the budgeted age at entry into the gilt development system and/or the breeding herd, and
- the proportion of gilts mated after their first heat (i.e. skip heats).

The schedule for delivering gilts into a farm or its gilt development system depends upon their entry age, the duration of time that gilts need to be housed in gilt facilities, the size of gilt facilities, and the number of gilts required to fully fill a transport vehicle.

4th Set service targets.

Service targets must be set dynamically according to anticipated changes in farrowing rate. Seasonal changes in fertility are abrupt, often occurring within 2 to 4 weeks. New Fashion Pork, Inc, (NFP) uses *% budgeted services* as a bonus incentive for its breeding departments. Thus, we reset service targets monthly. Records of ultrasound diagnostic tests can be used to predict farrowing rates based upon 28-day ultrasound tests and the percentage of females falling out between the 28-day test and farrowing (% fallout).

5th Organize the breeding barn.

Barn organization is essential if all subpopulations of females are to be easily found and available as needed. Gilts should be organized in pens or stalls by age and/or the occurrence of skip-heat events. Females that have been skip heated must be clearly identified as to the week that they will return to heat. The breeding barn must be set up with an "opportunity sow area" where each type of opportunity sow (e.g. LW, EW, PCN, ABORT, AC) is clearly identified. Recycles must be pulled from their old group in the gestation snake as they are found in heat and replaced in the breeding line or with their new service group in the gestation snake. Open spaces in the gestation snake must be promptly filled with pregnant females from the parking area as soon as animals are detected open.

6th Develop weekly service budgets.

Service budgets are a weekly plan for how budgeted number of services will be achieved. The plan is developed weekly late in the week prior to when females are to be bred. It should project the overage/underage for number of females likely to be bred based upon:

- the number of weaners predicted to return to estrus following weaning,
- the number of available gilts (including skip-heat gilts) predicted to come into heat,
- the number of served females likely to return to service (recycles) and
- the number of opportunity females projected to return to heat during the following week.

Weekly service budgets must be monitored closely (e.g. at quarterly intervals) to ensure staff compliance. In order for them to be useful, breeding barn staff must be forced to use service budgets. This can be accomplished by periodically checking how close the service budgets prepared one week actually match what was mated on the following week

7th Monitor the breeding system.

The breeding system should be monitored weekly to ensure that budgets and targets are being achieved and that subpopulations are being managed as planned. The monitoring of gilt-related activities is particularly important, since this is the one subpopulation, of the four subpopulations in the service pool, that can be most easily manipulated in order to achieve service targets. There are several areas warranting special attention. Are the budgeted numbers of gilts being served each week? Are gilts being mated at the budgeted age? Are sufficient gilts being skip heated before they are bred? As discussed below, a *gilt availability report* will need to be designed to enable the viewer to efficiently and effectively manage the gilt pool.

Weaned Pig Quality

While having smaller litters, first-litter sows tend to have heavier birthweights and more uniform pigs at farrowing than multiparous sows. They may milk as well as mid-parity females and typically better than older parity sows. Consequently, weaning weights and weaned pig uniformity often are better for primiparous sows than for older sows. Start-up herds and those having a left-shift in their parity distributions usually have better quality pigs at weaning than established, mature herds.

Herd Health

The gilt is the **most important** cause of herd health instability. Gilts carry pathogens into the herd with them, thereby exposing naïve individuals in the herd. Naïve gilts can be exposed post entry to shedding sows in an unstable herd. Either way, infusing gilts into a herd is similar to "pouring gasoline onto a fire." There are several steps that can be used to reduce the detrimental impact of the gilt in the health stability of the breeding herd.

- Gilts can be acclimated, by exposing them to shedding pigs, so that they are immune and no longer shedding at herd entry.
- They can be vaccinated against agents endemic in the herd prior to herd entry.
- Replacements can be produced internally, via on-site, internal multiplication, so that they are immune to the agents present in the herd by the time they are delivered to the breeding barn.

▪ Measures of Gilt Performance

Budgets and Targets

Budgeted numbers refer to what you project that a farm will do. Because they are readily achievable, they are usually the numbers that are used in forecasts for lenders and owners. Budgeted numbers are also the numbers used to compute input use rates. Targeted numbers are what a farm strives to achieve. They should be "a reach;" that is, not readily achievable, but achievable with reasonable extra effort. Both budget and target numbers should be calculated for endpoints used to measure how well gilts are being managed.

Management Endpoints

There are several endpoints used to assess how well farm staff members are managing gilts. Some assess how well either chronological or physiological

age is being managed. Some assess how well farm staff members are managing the inventory of gilts in the farm or its gilt development unit. Other endpoints can be used to assess how quickly gilts are bred or made available to be bred.

Age-related Endpoints.

Several endpoints can be used to assess how well the system is being executed to optimize the maturity of the gilt when first mated. These include:

- age at first service
- % gilts served greater than the budgeted minimum age
- % gilts served that have a skip heat event
- age at 1st skip heat

Inventory Management Endpoints.

Several endpoints can be used to assess how well gilt inventories are being managed. These include:

- total number of gilts in the gilt pool
- % total female inventory in herd that are unbred gilts
- number of gilts in gilt pool that are available to be bred (i.e. size of available gilt pool)
- ratio of number of **available** gilts to number needing to be bred. If all available gilts are cyclic this ratio would be 3:1. Typically, when available gilts are a blend of cyclic and acyclic gilts, this ratio will be greater than 4.5.
- % replacement rate
- % gilts entering a herd that are removed prior to service
- % selection rate (the proportion of gilts entering a gilt development system that eventually make it into the breeding herd)

Intervals Relating to Gilt Management.

The key endpoint used to assess how quickly the gilt becomes productive is **entry to 1st service interval**. It can be decomposed into its two components:

- entry-to-available interval
- available-to-1st-service interval (days from becoming available until served)

Productivity Endpoints

Prime Numbers of Productivity.

Prime numbers are those that cannot be readily decomposed into component parts. They are the key drivers of herd productivity. Prime numbers of gilt productivity that are commonly assessed include born-alive litter size and farrowing rates. While being a prime number for the breeding herd, at large, preweaning mortality is seldom a problem for first-litter sows and, thus, is not a prime number used to assess gilt performance in isolation from the remainder of the herd.

Sow Longevity.

Numerous studies have demonstrated that the management of gilts during rearing and age at first service potentially affect the survival of sows in a herd. Because gilts are managed to improve herd productivity, there are at least four endpoints worthy of monitoring:

- pigs born alive/sow lifetime
- pigs weaned/sow lifetime
- litters farrowed/sow lifetime
- parity at removal

▪ Establishing the Correct Gilt Flow for a Farm

Computer models are very useful in figuring out gilt flow for a farm and size of gilt development facilities needed. Being relatively easy to construct using spreadsheets, they should consider the desired delivery frequency in the computation of the number of gilts needed in each delivery. To do this meaningfully, gilt flow models should also consider:

- budgeted age at which gilts are delivered into the gilt development system
- budgeted age at which gilts will exit the gilt development system
- budgeted age at which gilts enter the breeding farm
- budgeted age at first service
- time post mating that gilts will be put in the gestation snake
- expected removal rates prior to service (after gilts have entered the herd)
- expected selection rates during development
- changes in replacement (infusion) rates during the year

- facility sizes, including the sizes of:
  - the gilt development unit,
  - housing after entry into the breeding herd but prior to being made available,
  - housing after being made available, and
  - housing from when gilts are bred until they are placed in the gestation snake
- budgeted floor space allowance by age of gilts

Informatics

There are several essential elements to the effective monitoring of gilt performance.

Data Capture

Several bits of information must be captured on individual gilts, including: dates of birth, entry, skip heats, service, treatments with PG600, and removal.

Projection of Gilt Needs

Projections must be done for a period as far in advance as possible. It is desirable that projections be done for a time period beginning when gilts are dedicated to a sow farm until they are available to be bred into a service group. Accurate group sizes are typically available for gestating (16 weeks), lactating (3 weeks) and weaned groups (1 week). Thus, gilt needs projections can only be done accurately for 20 weeks in advance.

Monitoring of Gilt Availability

In order to improve the efficiencies associated with gilt performance, management must ensure that sufficient gilts are available at the desired age and after having the targeted number of skip-heat events. In well managed systems, just having enough gilts to achieve service targets is not enough. The gilts must be old enough, from both a chronological and physiological standpoint.

Monitoring of Gilt Handling

How gilts are being handled by farm personnel should also be considered, including such things as the proportions of gilts being (1) bred too young, (2) culled prior to breeding, and (3) treated with PG600.

Monitoring of Gilt Performance

All competitive computerized information systems report litter size and fertility by parity. This allows the gilt's biological performance, relative to other parities, to be easily assessed. NFP uses a template, called "Ultrasound Diagnostic Record" to determine how the gilt differs from other parities in various measures of fertility, including pregnancy check positive rates at 4 and 7 weeks of gestation, rates of pregnancy when visually examined at 11 weeks of gestation, and farrowing rates.

▪ In-the-barn Information Systems

Real-time information management is only possible when the in-the-barn systems tell the farm staff (1) when an event has occurred or a date has arrived keying an action by a technician and (2) what management practice must be performed on the gilt at that time. While a computerized information system is a necessary tool for managing the breeding herd, it must be supplemented by in-the-barn information systems. The design of these systems is critical to their usefulness.

Gilt Identification

A simple method for permanently identifying gilts according to their birth or entry date is helpful for managing gilts in the barn. NFP uses a 6-digit slap tattoo number in which the year and week of a gilt's birth or entry date is included in her identification number. For example, "033124" would mean that gilt #124 entered the herd on the 33rd week of Year 2000. By having entry or birth date information in the gilt's permanent identity, the technician has access to information that allows them to more effectively manage individual animals.

Gilt Stall Card

NFP uses a different stall cards for each of the four major female types (weaner, recycle, opportunity, and gilt). The gilt card allows gilts to be managed real-time (i.e. in the barn), such that anyone looking at a the card:

- has immediate access to pertinent lifetime information (e.g. entry dates, skip heat dates, PG600 treatments) and
- knows when certain actions need to be taken (e.g. dates when PG600 treatments should be given, when gilts should be placed in "stress pens," or when gilts should be removed from the herd for failure to farrow following service).

Data Capture Forms

Forms used to capture gilt information in both the gilt development unit and gilt area of the breeding farm should capture requisite data simply and accurately to allow for subsequent entry into a computerized information system.

Gilt Group Numbering

As with sow service groups, NFP identifies each group of entering gilts with a number consistent with either the week or 1000-day date that the gilt group enters the herd. For example, Group 41 refers to the group that entered on Week 41 of the year. Group 357 refers to the group that entered on Day 357 of the 1,000-day calendar. Group numbers are used to sort gilt information so that individual group performance can be tracked.

▪ Projection of Gilt Needs

Application

NFP uses a customized spreadsheet application, called the “Gilt Needs Projections ” to determine dynamically how to vary rates of gilt introduction into a herd. Projections are run monthly.

Basis for Projections

Steady state needs for replacement gilts are dependent upon:

- budgeted replacement rate
- herd’s breeding female inventory
- post entry selection rates
- proportion of gilts not cycling following entry
- age when gilts enter the farm

Factors Influencing Gilt Needs

Several factors cause fluctuations in gilt needs:

- seasonal changes in fertility, percent of entering gilts served, age of puberty, and synchrony of puberty
- group-to-group variations in weaning group size
- changes in the budgeted age when gilts become available

- changes in replacement rates (as occurs with the implementation of a parity correction plan)
- non-seasonal temporal variations in fertility

Gilt Needs during a New Herd Start-up

The ramping up a start-up herd or the repopulation of a new herd requires the consideration of several additional variables. In planning the infusion of gilts into a new herd, NFP uses a custom template, called "*Gilt Needs Projections for a New Herd*." In addition to the above inputs, it considers:

- timing and sizing of gilt deliveries to ensure that service targets are met
- staging of gilt deliveries to ensure that gilts are mated after being skipped heat and above a minimum age
- establishing ongoing regular replacement rates after startup is complete

▪ Monitoring Gilt Pool Management

NFP captures its gilt information in a commercial software program, called PigCHAMP. It then exports that data to a custom designed database system called the "*Gilt Availability Report*." This report allows the monitoring of how gilts are performing after they have been delivered into the herd. It measures endpoints weekly over time following the periodic introduction of gilt groups.

- % gilts served at greater and less than targeted minimum age
- % gilts treated with PG600
- % gilts served and % remaining to be served
- % gilts with skip heat event and age of 1st skip heat
- % gilts culled or dying

It also allows the user to make decisions "on the fly" as to how the gilt pool should be managed in order to achieve service targets. That is, what you can change in gilt pool management to make sure that you achieve service targets while maximizing gilt maturity.

▪ Design of a Gilt System

The gilt system holds gilts from the time they enter the gilt development system until they are served in the breeding farm. The design of a gilt system and the

associated flow of gilts through it (as discussed previously, in *Establishing the Correct Gilt Flow for a Farm*) is critical for achieving health stability in the breeding farm, ensuring that sufficient gilts are available to meet service targets, and ensuring that gilt biological performance is optimized. There are several considerations that should be given to gilt system design.

Gilt Development Unit

The gilt development unit includes the phases of development that occur after gilts become dedicated to a particular breeding farm. It may include the nursery as well as finishing stages (e.g. 3 to 27 weeks of age), the finishing phase alone (e.g. 11 to 27 weeks), or the final weeks of the finishing phase that occur just before a gilt enters the breeding farm (e.g. 22 to 27 weeks). During this phase gilts are usually acclimated to diseases endemic in the breeding herd and are vaccinated against agents that may affect the health of the gilt (e.g. mycoplasma, swine flu).

Isolation/Acclimation Unit

The isolation/acclimation (IA) unit may be on the same site as the breeding herd or on a site remote from the herd. Gilts are typically housed here for only a few weeks to allow (1) additional diagnostic testing, (2) time to manifest any signs of endemic disease, and (3) time to "cool down" so that gilts no longer shed agents into the breeding herd upon entry. This stage may also be when gilts are vaccinated against agents that may affect their reproductive performance (e.g. leptospirosis, parvovirus).

Gilt Area of the Breeding Farm

The gilt area of the breeding farm may be either a separate area of the breeding barn or a separate barn on the farm. Upon entry into the farm, gilts are typically housed in this area of the farm for varying lengths of time. In some NFP farms, gilts are housed in the gilt area from entry, through breeding, until early gestation when pregnant gilts are used to backfill spaces vacated in the gestation snake by nonpregnant sows. On these farms, gilts constitute the parking area used to backfill the gestation snake. At other NFP farms, the gilt area houses gilts through gestation until they are loaded into farrowing. To facilitate inventory management, gilts should be tattooed during the first week after arrival into the gilt area of the breeding farm. As gilts pass through the gilt area, daily boar exposure to induce estrous cyclicity is initiated. If the farm does not have an isolation/acclimation barn, gilts will be vaccinated while in the gilt area.

Gilt Gestation Snake

On most breeding farms, gilts are placed after mating along side sows in the gestation snake. On farms that have persistent health instability, NFP uses a separate gilt gestation snake from its sow snake. When possible on these farms, gilts are farrowed in separate farrowing rooms from sows. In this manner, gilts are thought to be more gradually exposed to pathogens in the herd, and additional time is allowed for shedding gilts to “cool down” after exposure to pathogens. Consequently, greater health stability is afforded the herd, as well as allowing gilts and sows to be fed and managed separately.

Estrous Induction and Breeding in Off-farm Facilities

When the bottleneck of a breeding farm is the breeding /gestation facilities, gilt groups can be (1) induced to commence their pubertal cyclicity, (2) bred, and/or (3) gestated, entirely or for part of their gestation, in facilities off-site from the breeding farm. Off-site housing of gilts is especially useful during the summer months when achieving breeding targets becomes more difficult.

▪ Cost Management

Key Factors Influencing Gilt Genetic Costs

Control of the gilt genetic cost component of the cost of production for market pigs includes:

- breeding herd replacement rates
- sow lifetime productivity (pigs marketed/sow/lifetime)
- depreciation schedule used for breeding stock
- genetic royalty or fee paid to genetic supplier
- costs associated with rearing the gilt pre-service.

Costs Associated with Gilt Development

Several factors influence the cost of rearing a gilt prior to entry into the breeding herd.

- stocking densities and facility utilization in the gilt development unit
- mortality and selection rates
- vaccination and treatment programs
- diagnostic testing

- staging of diets and nutrient density of diets
- labor and service costs.

▪ Practical Tips for Managing the Gilt

Where Gilts Should Be Mated

On most modern breeding operations, females are mated multiple times during an estrous period. Weaners are usually weaned into the breed line where they are mated for the first time. The second and third matings, if they occur, can occur in the breed line *prior to* the sows being moved to the gestation snake, or weaners can be remated *after* they have been moved to the gestation snake. Opportunity females can be moved to the breed line for their first mating or mated the first time while still in the opportunity section of the barn. Subsequently, they usually tend to be handled as weaners. Recycles can be bred where they are found in the gestation snake then moved to the breed line, or they can be moved to the breed line for their first mating. On most farms, the fertility of weaners and opportunity sows are similar; gilts and recycles having lower fertility. On some NFP farms, the fertility of gilts is as high as weaners or opportunity sows. NFP has achieved high gilt performance by having all matings in the location that gilts were housed when originally detected in heat. Thus, gilts that have been skip-heated will usually be bred in stalls in the gilt area. Gilts that have not been skip-heated but are old enough to be bred will usually be bred in pens before being moved to gestation stalls.

Acclimation

In theory, acclimation allows incoming replacements to become immune to diseases endemic in the herd. As currently conducted by the swine industry, acclimation is fraught with several problems:

- the animals being used to expose gilts being acclimated may not be shedding the agent at the time they are in contact with the gilts,
- not all of the gilts being acclimated may be exposed to the agent, resulting in the immunity of the group being incomplete, or
- gilts being acclimated may become immune but may continue shedding the agent after addition to the herd.

In order to minimize the occurrence of acclimation failures, NFP monitors gilts serologically during the acclimation process to ensure that all gilts seroconvert following exposure. Monitoring becomes more meaningful when gilts are seronegative at the beginning of the acclimation process. In order that they have sufficient time to be exposed and “cool down,” gilts should be exposed

early during the acclimation period. NFP's target is for seroconversion to occur within the first 6 weeks after placement in the gilt development system. In our experience, culled females are a highly inconsistent source of the inoculum needed to expose naïve gilts. Tissues or "seeder" pigs known to be infected with the agent are more reliable sources of infectious material. Regardless of the source of the inoculum, getting naïve gilts initially exposed is highly unreliable. In addition, even after the disease becomes endemic in a gilt development unit, it may be difficult to keep it moving from groups having established infections to naïve groups.

Optimizing Selection Rates

In order to optimize selection rates, gilts should be kept healthy throughout the development phase. Because the acclimation process exposes them to pathogens, keeping gilts healthy requires that gilts be vaccinated prior to the start of acclimation and they be treated promptly and aggressively if they become ill. Gilts should also be provided plenty of floor space. At NFP, selection rates have been found to increase substantially as floor allowances were increased from 9 to 12 ft^2/gilt (0.85 to 1.15 m^2/gilt). Diets that cause rapid growth rates (e.g. market pig diets) are associated with increased fallout rates of developing gilts. The number of times gilts are moved and mixed should be reduced: gilts should be put in their pens and left there throughout the development phase. Rearing gilts on partially slatted floors, versus totally slatted floors, reduces the proportion of gilts culled for feet and leg problems. In general, replacement gilts cannot be treated like finishing pigs.

▪ Conclusion

Treat gilts like the valuable resource that they are. As stated at the beginning of this paper, gilts are the fuel for the breeding herd. Improved gilt management will lead to more weaned pigs/unit of time and more pigs weaned/sow/year. Proper gilt management is one of the major keys to competitive herd performance and profitability.