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Our approach to the theory of constraints in pork production

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Introduction

Today only a few holdouts continue to insist that system or process improvement methodologies will not work in pork production. Their cliché caveat is "it's a biological system with too much variation!" By now they have either been proved wrong or invited by their banker to try a different occupation. Today we now discuss which methodology to use and often approach the subject as if comparing between church denominations, rather like this industry used to approach production record systems a decade or so ago. Each following has its own jargon and secret handshake, etc.

In this paper we'll discuss some of the ways in which we at Swine Graphics Enterprises (SGE) apply the theory of constraints (TOC) to pork production. To some extent this discussion will include explanations of TOC, but a full treatment of the TOC body of knowledge is beyond the scope of this paper and it is assumed that the reader already has at least some knowledge of Dr. Eli Goldratt's books on TOC (not just *The Goal*).

Background

I personally began studying TOC in late 1994 and attended the Jonah Program training at the Goldratt Institute in New Haven, Connecticut in January–February 1996. Certainly at that time and to a lesser extent even today, TOC suffers from a perception that it is "only for the shop floor." For many, TOC is only what they read in Eli Goldratt's 1984 business novel *The Goal*; they are unaware of TOC's continuing evolution—applications and tools that have been added or re-engineered over the years. Therefore, most attempts to apply TOC to pork production were simply "searches for Herbie," (i.e., production bottlenecks).

TOC includes a suite of applications: production, distribution, project management, among others. These are used as templates with an actual deployment, requiring customization for a specific organization. In addition, TOC includes a suite of logic tools (the "thinking processes") that can be used to construct a breakthrough solution where none of the existing applications fit. We resorted to using the thinking processes (TP) to understand the underlying conflicts that block us from more intelligent and profitable pork production. Interestingly, the resulting solution bears more resemblance to the TOC distribution application than to production! This fact is quite ironic given the common initial misconception that a production approach, as described in *The Goal*, must somehow work for pork production, too!

Anybody that professes to be perfect or claims that their organization is applying some improvement methodology perfectly to maximize their ROE is stretching the truth. SGE is no exception. We think we do a fairly good job at applying TOC, but we know we could do better.

The basics

The theory of constraints observes that a system is a chain of interdependent processes. Each process exhibits variation over time in process speed, yield/scrap, etc. One aspect of TOC is about how to manage such a system given that this variation occurs. In pork production, we rarely quantify these process variations—most record systems don't report them. Instead we focus on means: average liveborn, farrow rate, pre-wean mortality, ADG, etc. We even design production systems using these means to calculate flow and capacity requirements. Intuitively we know that these statistics vary over time. We have even used this as an excuse for not pursuing continuous improvement.

Balanced capacity systems do not mix with process variation. The unavoidable result will be floating bottlenecks. So why do we design for balanced capacity? The reason is that we have the belief that excess capacity anywhere in a system is wasteful and costs us profits. What is your reaction if you observe an empty gestation crate or an idle finisher? Heaven help the breeding manager if a few gestation crates are empty! Most process improvement methodologies target the reduction of waste. They quantify this as maximizing resource utilization. Conversely, TOC strategically places "protective capacity" in a system's chain of processes.

A TOC approach to pork production involves the question "what do you want your capacity-constraining resource (bottleneck) to be?" This is not a flippant question; the answer is a strategic one that needs to consider breeding animal capital costs and finisher contract terms/

availability, to name just two. Once this choice has been made, all other resources must be slightly oversized relative to this resource's capacity. Therefore, they will often (but *not* always) appear to have some excess capacity. Is that wasteful? No, it protects the system's ability to withstand the impact of natural process variation and maintain a higher rate of generating margin as product is sold. Any other approach will result in reduced profits.

On the one hand, this is intuitive and might elicit a "well, duh" response. However, consider the impact on traditional efficiency and resource utilization measurements. The entire performance measurement system must change to coincide with the new operating paradigm.

Management accounting

Most managers make bad decisions using accounting information. The secret is that GAAP accounting reports are not to be used to make operational decisions. Management accountants know this, but this knowledge (and reasoning) never trickled down to operations folk. Underlying the dangers in misapplying these data is the difference between fixed and variable expenses. Just because a report expresses a ratio obtained by dividing some expense total by some units of production (e.g., pounds or head), it doesn't mean that incrementally greater or lesser production costs or saves that number of dollars!

One of the more amusing "war stories" I heard at a TOC conference comes from a big-name U.S. paper company that had a central printing/copying facility at its headquarters. It remodeled some unused warehouse space, put some copiers in it, and staffed it. This service became a "cost center" and the total expenses (that included prorated facility expense based on square footage) were divided by the number of copies generated to arrive at a fee per copy that was charged to the various departments using this service. The problem was that this charge was slightly higher than the same service from Kinko's. Therefore, department managers began taking their projects to Kinko's so that their departmental income statements would look better. This reduced the volume for the in-house copy center but most of its costs remained constant. Therefore, it had to charge more per copy. The problem accelerated. The department managers appeared to be doing the smart thing but the impact on the company as a whole was clearly negative.

This type of accounting folly can and does happen in pig farming, too. Trucking is a common example. Buying or selling feeder pigs is another example. Trying to maximize market price received per pound sold or minimize sort loss rather than maximizing gross revenue minus variable costs for each load is the prime example!

TOC throughput accounting

Any reader familiar with Goldratt's theory of constraints has heard of the accounting metrics: T, I, and OE which represent throughput, inventory (or investment), and operating expenses, respectively. In pork production, the term "throughput" already has an existing connotation related to pork out the door. In order to reduce confusion, we use the term "contribution margin" instead of T. The definition is the same: revenue minus totally variable costs. To be precise, the denominator for T is a unit of time.

At SGE we seek to maximize the contribution margin generated by each load of pigs sold. The corresponding marketing question is "if we defer selling load #N from barn ABC until next week, will it generate additional contribution margin?" In other words, will the load's incremental revenue exceed its incremental variable cost? If we need the barn for incoming pigs, then the above question is moot. When groups are closed and remaining loads are sold, we sum their forgone contribution margin. Interventions are cost-justified against any reduction in this forgone contribution margin. As a clarification, changing the number of nursery/finisher spaces is as valid an intervention consideration as changing rations or treatments.

Changing the number of groups sold per year by buying or selling weaned or feeder pigs or allowing sow farms to wean more or less pigs is assessed by comparing the probable incremental contribution margin of these particular groups against the change in contribution margin of all the other groups affected during the event. For example, inserting a group of feeder pigs may truncate the growth of several subsequent groups and increase their forgone contribution margin. Additional production from a sow farm may overrun its nursery/finisher system and thereby truncate the growth of subsequent groups, and possibly result in younger wean ages which requires more expensive starter rations and also reduces the end weight and contribution margin of these affected groups.

This should sound like common sense. However, the number of arguments we've had with others about the importance of sort loss, for example, suggests that this reasoning is certainly not common practice.

TOC "pull" approach

To facilitate a "pull" approach to marketing at SGE we generate a weekly report that estimates the sale date for each load of pigs on feed such that each load's contribution margin is maximized. This algorithm considers factors for recent growth performance and current market prices of pigs and feed. Following the actual first sale from a group, the remaining loads' scheduled dates are adjusted using the estimated versus actual first load

weight. It also projects weaned pig flow from sow farms and uses this data to estimate each group's closeout date, at which time the remaining loads' growth is obviously truncated and their potential for additional contribution lost. Other weekly reports "pull" gestations, matings, and replacement gilt deliveries to maintain the target wean pig flow at the target wean age.

This suite of reports and their underlying algorithms required huge intellectual investment. It was also no trivial task to switch from management-by-efficiency-measurements and the mentality of stuffing production through the system plus maximizing resource utilization to this "pull" approach to production using measurements that assess compliance to, and minimal variance from, a specified target performance at each process.

System focus

The theory of constraints helps us understand that pursuing local efficiencies at every process within a system is counterproductive. Removing what may appear to be wasteful excess capacity might actually erode necessary protective capacity that accommodates the natural surges through a system due to normal variation. Sometimes the term "surge capacity" is used synonymously with "protective capacity." It reflects a level of capacity that is frequently only partially utilized, yet it is required often enough that the incremental cost of providing it is more than recouped by the amount of incremental contribution margin that it enables. Examples include: gestation crates sufficient to house additional females required to offset periods of low litter size or farrow rate, some of which are idled when performance improves. Another example is a stream of replacement gilts large enough to fill breeding deficits of varying size.

Obviously the incremental cost of providing protective capacity varies among the various resources of a pork production enterprise. The process associated with an expensive resource's protective capacity is the logical and obvious choice for a process improvement effort. The caveat, of course, is that an actual reduction of cash expenditures is possible. For example, we have traditionally targeted things that save staff time but did not result in any reduction in payroll expense. Once a process has been selected for improvement, whatever process improvement tool bag is comfortable is certainly acceptable. The point of TOC is that the system focus pinpoints the area that will yield the "biggest bang for the buck" in terms of improvement efforts.

In pork production, the top priority is to extract as much contribution margin out of the groups sold as possible. Ironically—to some—this is achieved not at the weight that maximizes revenue per pound, but beyond this weight. In order to maintain this goal, the stream of pigs weaned must be relatively stable, synchronized with the designed level and fill schedule of the nursery/finisher system. Anything below this level is obviously a hole in production. Anything surging above this level tends to result in lower wean ages of pigs weaned during the surge and more expensive starter diets. In addition, surges tend to force finisher groups out lighter, thereby sacrificing their potential contribution margin. This truncated growth continues until some future hole in production lets the nursery/finisher system catch up or until additional nursery/finisher capacity is found. In order to achieve a stable wean pig flow, the sow herd must be allowed to fluctuate up and down as opposed to keeping gestation spaces full. This practice is contrary to maximizing traditional sow herd metrics such as: (pigs weaned per sow*year) or p(igs weaned per farrowing crate*year). Therefore, it may also run contrary to labor compensation schemes, which are typically put in place to encourage maximum production rather than targeted production.

Traditionally "cost cutting" has been the battle cry of managers regardless of the industry. TOC certainly advocates cost cutting, but only in the context of not compromising contribution margin. Without the system focus, expenses are often slashed in some segment of the production chain that actually reduces the enterprise's contribution margin by an even greater amount! TOC further warns against pseudo cost-cutting that is naïve to fixed versus variable costs. In other words, if some intervention does not truly reduce money out the overall enterprise's door, it isn't helping profit. As an example of this last point, consider the difference in cull rate's significance between systems that purchase replacement gilts and systems that have their own multiplication.

Conclusion

At SGE we've implemented a production system based on TOC principles for managing overall systems of chains of processes that exhibit variation. This has been not just a change in philosophy but in management logistics, capacity planning, and performance measurement systems. In the context of maintaining a higher rate of generating contribution margin, processes are prioritized for improvement as they jeopardize this goal or if we can realize true cost savings at the process without an offsetting reduction in contribution margin. In addition to this focus, the reduction in floating bottlenecks because our processes' capacities are not balanced has helped our ROE and sanity.