Application of an Integrated Management System to Improve Performance and Profitability in Finishing Pigs

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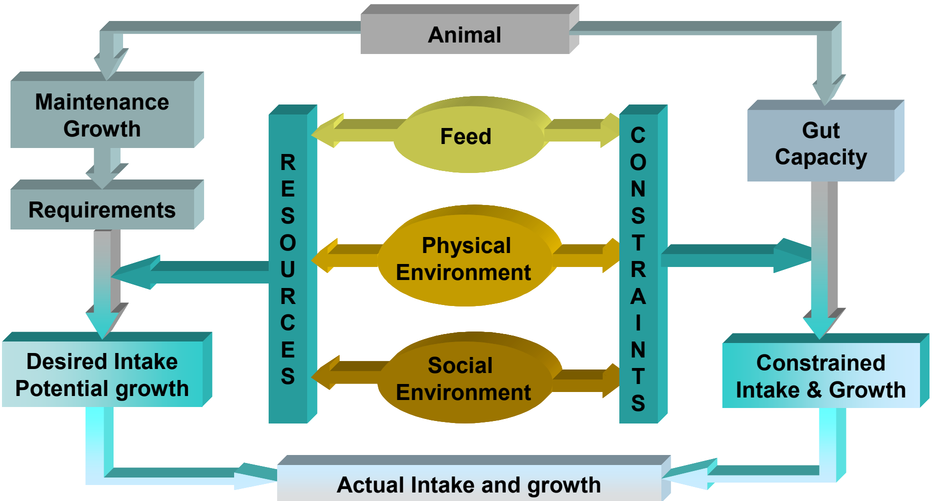
■ Introduction

Simulation of animal growth for the purposes of predicting the responses of pigs to nutrient inputs is not a new concept nor a new practice, with initial explorations dating back to the late 1970's and early 1980's (Whittemore & Fawcett, 1976; Emmans, 1981). Subsequently, a plethora of models differing in complexity and application have been reported in the scientific literature each with their own unique conceptual framework and predictive objectives (Black et al., 1986; Pomar et al., 1991; Ferguson et al., 1994; Moughan et al., 1995; Birkett and de Lange, 2001; Green & Whittemore, 2003; Wellock et al., 2003). The extent to which these models have been successfully transcribed into commercial applications has varied due to their complexity, ease of use and the robustness of their scientific theory to accurately predict performances under commercial conditions. Despite the varying degrees of success, there is no doubt that the integrated management approach to predicting growth and feed intake, significantly enhances the decision-making process. It quantifies both the technical and financial outcomes to production stimuli, and therefore eliminates the need for educated guesses. This paper will outline key components of an integrated simulation model, Watson® and how it has been applied within Nutreco Canada.

■ Watson® Overview

Watson® was developed by integrating the science and practice of pig production into an easy to use Web-based software application. The science and theoretical framework have been extensively validated with over 20 trials conducted to test significant drivers and components of the model. Its framework is unique and flexible to allow the prediction of voluntary feed intake, as well as predicting performance and financial outcomes reasonably accurately under commercial conditions. For a detailed description of the program refer to Ferguson (2006). The key components of the model are summarized in **Figure 1**.

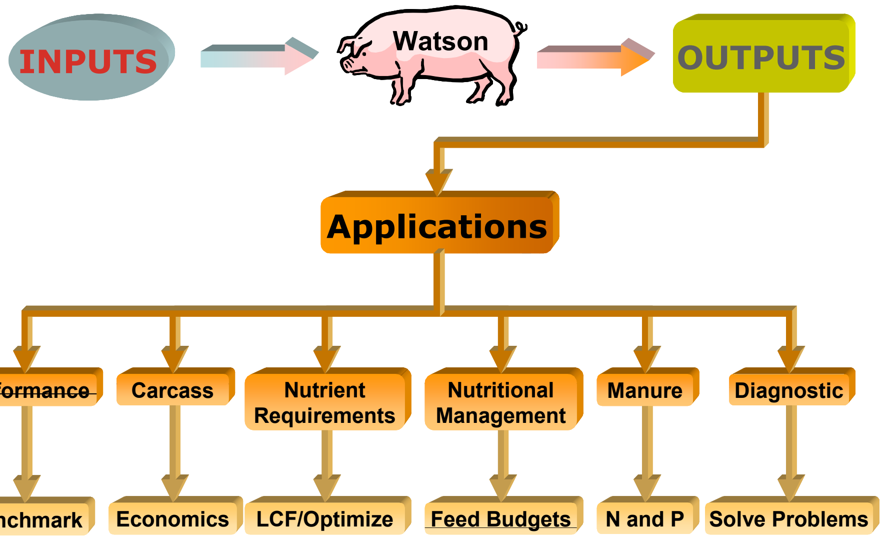
Figure 1. The framework summarizing the key components and processes involved in the Watson® model.



▪ Applications

One of the main purposes of Watson® is to integrate the complex interactions between the animal, its environment and its diet into a management system that accurately predicts the animal's performance under commercial conditions, including cause and effect responses to any change in the production environment. Therefore, the application of Watson® provides solutions to a number of production, economic, and nutritional changes as well as assisting in the diagnosis of potential production problems. **Figure 2** summarizes the potential commercial applications of Watson®.

Figure 2. Summary of the commercial applications of Watson®.



Production changes

Outputs from Watson® allow one to monitor current performances with expected performances and therefore identify periods of slower growth during rather than after the grower/finisher period. In addition, performances can be benchmarked against other producers or previous close-outs.

Economics

Judicious use of Watson® can simulate market performances for any predefined grading grid, including optimum solutions for individual producers, and the financial implications of any production changes (e.g. health, stocking density, nutrition and environmental changes). Clearly, as feed and hog prices change so to will the optimum marketing strategy change for a producer. For example, the average hog shipping weight to provide the highest gross profit may be lower when feed prices move up and hog prices move down (**Table 1**). The extent of the change will depend on the specific packer to which the hogs are being shipped. There are also opportunities to consider whether barrows and gilts should be shipped at different weights.

Table 1. Predicted optimum average shipping weights associated with changes in hog and feed prices (Average: Hog Price=$1.50, Feed costs = $230-$250/MT; Hog Price: Low = $1.10, High = $1.70; Feed Costs: Low = -$30, High = +$30/MT).

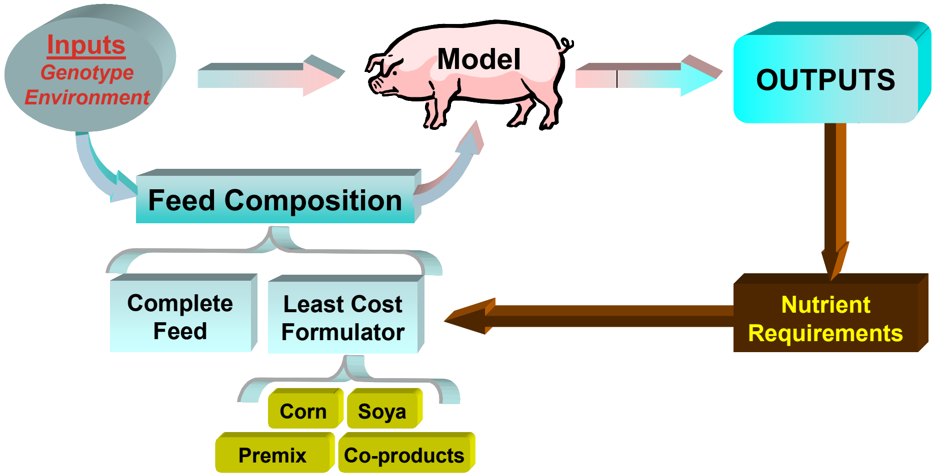
	Scenario		Optimum Shipping Weights (kg)														
Grading Grid	**Hog Price**	**Feed Costs**	**108**	**109**	**110**	**111**	**112**	**113**	**114**	**115**	**116**	**117**	**118**	**119**	**120**	**121**	**122**
Processor A	Average									■	■	■	■				
	Low	High		■	■	■	■	■									
	Low	Low						■	■	■	■						
	High	High									■	■	■	■			
	High	Low											■	■	■	■	
Processor B	Average												■	■	■		
	Low	High								■	■	■					
	Low	Low										■	■	■			
	High	High											■	■	■		
	High	Low												■	■	■	
Processor C	Average							■	■	■	■						
	Low	High	■	■													
	Low	Low		■	■	■	■										
	High	High						■	■	■	■						
	High	Low									■	■	■				
Processor D	Average										■	■	■	■			
	Low	High						■	■	■	■						
	Low	Low								■	■	■	■				
	High	High										■	■	■			
	High	Low											■	■	■	■	

Nutrition

Watson® has the dual capacity to access and utilize existing branded products, or perform least cost formulations for individual customers based on the predicted nutrient requirements of their genetics, health status and their ingredients (**Figure 3**).

With these features it is possible to 1) determine the optimum nutrient requirements based on the producer's economic or performance objective, for different nutrient density of the diets, and for different feed budgets; 2) minimize under and over-feeding nutrients; and 3) estimate the impacts of alternative technologies such as Paylean®. Of particular importance is the ability to define optimum feeding strategies based on current feed ingredient prices, as well as future ingredient prices. Therefore, responses in gross profit to changing energy density and/or the lysine:energy ratio of the diet can be predicted.

Figure 3. Application of nutritional components within Watson®.



Nutritional or Feeding Management

A common question asked by producers is how many feeds should I be feeding in the grower/finisher phase and, if I use more than one, when should I switch feeds? The answers to these questions can influence the producers gross profit and therefore a feeding budget can be designed and implemented to optimize the producers objective (which could be either higher gross profits per pig or per annum, faster growth rates or best feed efficiency). Running a number of scenarios through Watson® will allow one to predict the optimum feeding budget based on cost versus nutrient requirement for any growth period. In addition, it is also possible to compare different diets and their effects on the performance objectives.

Manure Management

One of the consequences of being able to predict daily feed intake and lean tissue deposition is the ability to determine the amount of nutrient excretion, especially nitrogen and phosphorus excretion. For every simulation it is possible to determine the total amount of N and P that is excreted per pig per closeout period. Where N and P excretion is closely regulated, Watson® can be used to develop feeding programs, including diets and feed budgets, that will reduce excretion of N and P. For example, moving from a 3-phase to a 5-phase feeding program can reduce N excretion by 50g/pig, which translates into a 135kg N reduction per year for a 1000 pigs per closeout barn.

Diagnostic or Problem-solving applications

Because predictions are performed on a daily basis it is possible to estimate the factors that influence feed intake and growth as well as those factors that may constrain or limit performance. Therefore, with an understanding of the model theory it is possible to identify and solve production problems.

■ Conclusion

The ability to make well informed economic decisions in a complex and constantly changing production environment is becoming increasingly dependent on the application of integrated management models. Watson® can dynamically assimilate the whole production process in order to predict the cause and effect responses to vectors of change within the commercial production environment.

■ References

Birkett, S. and C.F.M. de Lange, 2001.A computational framework for a nutrient flow representation of energy utilization by growing monogastric animals. British Journal of Nutrition 86:661-674.

Black, J. L., R.G. Campbell, I.H. Williams, K.J. James and G.T. Davies. 1986. Simulation of energy and amino acid utilisation in the pig. Research and Development in Agriculture 3: 121-145.

Emmans, G. C. 1981. A model of the growth and feed intake of *ad libitum* fed animals, particularly poultry. In: Computers in Animal Production. Eds. G.M. Hillyer, C.T. Wittemore and R.G. Gunn. Animal Production Occasional Publication No. 5, London. p.103-110.

Ferguson, N.S., R.M. Gous, and G.C. Emmans, 1994. Preferred components for the construction of a new simulation model of growth, feed intake and nutrient requirements of growing pigs. South African Journal of Animal Science. 24:10-17.

Ferguson, N.S. 2006. Basic concepts describing animal growth and feed intake. In: Mechanistic modelling in Pig and Poultry Production. CABI, Oxfordshire. p 22-53.

Green, D.M. & Whittemore, C. T. 2003. Architecture of a harmonized model of the growing pig for the determination of dietary net energy and protein requirements and of excretions into the environment. (IMS Pig). Animal Science 77: 113-130.

Moughan, P.J., M.W.A. Verstegen and M.I. Visser-Reyneveld, 1995. Modelling growth in the pig. Wageningen Press, Wageningen.

Pomar, C., D.L. Harris and F. Minvielle, 1991. Computer simulation of swine production systems. 1: Modeling the growth of young pigs. Journal of Animal Science 69:1468-1488.

Wellock, I.J., G.C. Emmans and. I. Kyriazakis, 2003. Modelling the effects of thermal environment and dietary composition on pig performance: model logic and concepts. *Animal Science* 77:256-266.

Whittemore, C.T. and R.H. Fawcett, 1976. Theoretical aspects of a flexible model to simulate protein and lipid growth in pigs. Animal Production 22:87-96.