The Convergence of ICT and Automatic Sorting System: A Quantitative Performance Analysis

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Abstract: This study examines the effects of the convergence of information and communications technology (ICT) and the automatic sorting system. The information technology collects pig weight data from the automatic sorting system and pig carcass weight and back fat thickness from slaughterhouse. By using the stored data, the information technology allows illustrating swine production performance by using visualization technology. The results indicate that the information technology indicates the change in average pig weight, average back fat thickness, and standard deviation of carcass weight before and after the installation of the automatic sorting system. From the results, the swine producers can evaluate their swine production management performance and make better decision for the improvement in swine industry.

Keywords: automatic sorting system, information and communications technology, convergence technology, swine production

1 Introduction

The development of the swine industry began in European countries such as Denmark and Netherland, which have an advanced livestock industry. Since the 21st century, the United States, Chile, and other European countries such as Germany, Spain, and Poland, have also been actively developing the swine industry. Breeding and feeding management systems for economic benefits have reached a mature stage. An increase in productivity has already saturated the market. Recently, there is a trend to improve the stagnant stage through the convergence of information and communications technology (ICT) and conventional industrial technology. Convergence technology allows the monitoring of various farm conditions by connecting conventional swine facilities and equipment to information systems (IS). Convergence technology also provides data that help evaluate management performance and provides better decision making for farm improvement.

This study examines the improvement of profitability in swine production through the convergence of an automated sorting system and management information system (MIS) of data collected in swine industry. The paper first introduces the function of an
automated sorting system and auto-sort advantages. Section two explains the effect for the convergence of ICT and an automated sorting system. Section three discusses the results of the convergence technology by displaying the quantitative data. Section four concludes the discussion with future research topics.

2 The Automatic Sorting System

The auto-sort system automatically measures the weight of pigs and determines which pigs are ready for the market. In conventional facilities, a trained individual visually estimates the pig’s weight for sorting. However, an auto-sort system performs the selection automatically by measuring accurate weight, which can reduce sort loss. As figure 1 illustrates, the auto-sorter operates according to the movement of pigs. As feeder and water supply are placed in a different court, pigs have to pass the sorter to drink water. In this method, the sorter can measure the weight of pigs in real time. When half of the pig’s body is on the sorter, the sorter recognizes the pig, closes the entrance door, and measures the weight. If a pig weighs lighter than the weight range, the swing gate opens to the food court. If a pig weighs heavier than the weight range, the swing gate opens to the area for market selection.

The companies that use an auto-sort system find the system effective and efficient in swine sorting and animal welfare. The sorter saves sort loss, improves feeding, and enhances marketing accuracy, and thus, has economic benefits. The sorter promotes consistent growth and allows accurate phase feeding for the pig to reach a desired weight range. The sorter is also programmed to decide when the pig is ready for market selection. According to a study by Gro Master, the hog group managed by the Pro Sort program had an 8.8 pound increase in average sales weight, 1.15% decrease in mortality rate, and $13.97 increase in revenue per carcass compared to the control group [1]. The data illustrates improved performance and economic benefits for the hog group managed by the Pro Sort program compared to the control group. The auto-sort system also improves animal welfare. The pigs can move around and scale utilization is encouraged rather than required. In addition, the auto-sort system reduces tail biting and fighting [2].

The automatic sort technology is mainly produced in European countries such as the Netherlands (Nedap, Dorset Farm System), Denmark (Domino), and Germany (Bug Dutchman, Mannebeck), and in the United States (Osborne, Schick Enterprises). In South Korea (hereafter, Korea), Porcitec, an Agritec Software Company, succeeded in producing a domestic auto-sort system. Ezfarm, Genetics Korea, and Seoul Livestock System are three more companies in Korea actively engaged in a sorter system.
The auto-sort system in Korea operates similarly to other auto-sort technologies described above. However, by applying ICT to the auto-sort system, it is possible in real time to collect and store pig weight data when they pass through the sorter, and carcass weight and back fat data from the slaughterhouse when grading pig carcasses. Data collected from the sorter and slaughterhouse can be graphed by visualization techniques. Trends can be easily observed from the collected data. In addition, by comparing data from the sorter and slaughterhouse, producers can predict the pig carcass grade from data stored by the sorter before marketing. For instance, Figures 2 and 3 describe the average weight of pigs in seven months by plotting the pig’s weight on the X axis and the number of pigs on the Y axis. Figures 4 and 5 illustrate the distribution of back fat in seven months by plotting the carcass weight on the X axis and plotting back fat on the Y axis. By displaying the stored data, producers can easily recognize the trends and distribution of the average pig weight and back fat, which are useful in evaluating business performance and effective in predicting the pig carcass grade before marketing.
The Outcome of the Convergence of ICT and Automatic Sorting System

The main benefit of the auto-sort system is to increase accuracy when marketing pigs. The pig carcass is graded by the carcass weight and back fat after slaughtering and after removing the head and organs. Although organ weights are different due to a difference in feed intake, the weight of a carcass has a close relation to the weight when pigs pass the auto-sort system. The thickness of back fat is also correlated with dressed weight. For this reason, it is important to control the pig weight to receive a high grade in the slaughterhouse.

To find the effectiveness of the auto-sort system, we compared the carcass weight and back fat thickness of Farm A before and after the installation of the sorter by using the carcass weight and back fat thickness data collected from September 2010 to February 2014. On average, Farm A markets 10 to 50 pigs per 2 to 3 times a month. Figures 6 and 7 describe an average trend that illustrate the carcass weight and back fat thickness for each market time. The red line indicates the time when the farm installed the auto-sorter system in late May 2012. Before installing the market pig sorter, the carcass weight often fluctuated. There was a high frequency of emergence for overweight pigs that weighed over 90kg. However, after installing the sorter, fluctuation of the carcass weight and the frequency of emergence of overweight pigs significantly decreased. In a pig farm management context, overweight is worse than underweight because the carcass grade drops when pigs are overweight regardless of a high pig feed consumption rate. In the case of back fat thickness, there was relatively high fluctuation prior to the installation of the market pig sorter. However, the fluctuation decreased after the installation.
Figures 6 and 7 are graphs that describe a trend for the standard deviation of carcass weight and back fat thickness for each market time. For both carcass weight and back fat thickness, compared to a large standard deviation prior to the installation of the market pig sorter, the standard deviation decreased after the installation. As carcass weight and back fat thickness determines the pig carcass grading, decreased standard deviation explains the lower possibility of sort loss. Thus, Figures 4 and 5 illustrate the before and after effectiveness for the installation of the market pig sorter.
The standard deviation of carcass weight before and after the installation of the market pig sorter decreased from 6.87 to 5.87. The standard deviation for the back fat thickness before and after the installation of the market pig sorter decreased from 5.0 to 4.74. As a result, a decreased standard deviation after installation of the sorter increased the high credit rating from 12.8% to 16.7%.

5 Conclusions

The main purpose for the use of the auto-sort system is to raise the accuracy when marketing pigs. The auto-sort system precisely measures the weight of pigs. The convergence of information and communications technology improved the auto-sort system because it allows the monitoring of various environmental factors on the farm. Data collected from this system allow the evaluation of business performance, which supports the decision making process. In this study, the connection between the information system and auto-sort system allowed collecting data from the sorter and slaughterhouse, and effectively illustrating a decrease in the number of overweight pigs and a decrease in the standard deviation of pig weight and back fat thickness. In
future studies, by attaching radio-frequency identification, it is possible to collect pig eating behavior data and the change in meat texture after marketing.

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**Reference**