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## **Study on the Analysis of Return on Investment of ERP Adoption in Agricultural Products Processing Center**

**Young Jin Lee**

Director, Department of Ag-tech, Ezfarm, Korea

**Jung Rock Do**

CEO, Korea Agribusiness Research Institute, Korea

**Young Chan Choe**

Professor, Agricultural Economics and Rural Development, Seoul National University, South Korea

### ***Abstract:***

*The purpose of this study is to improve the efficiency of APC decision making for introducing the ERP system by defining types of ERP and presenting the effect of each type and return on investment. ERP types can be broadly classified as full packaged type, Cooperative Grading Type and financial management type. As the result of a survey of 31 APC practitioners who introduced ERP, it was found that the ERP of cooperative grading type has the highest efficiency compared to before the introduction. As the result of ROI analysis of full packaged type and cooperative grading type, the payback period of full package type is 5.77 years (6.34 considering the discount rate) and the payback period of cooperative grading type is 3.53 years (3.88 considering the discount rate). The result of this study expects to minimize the trial and error for decision making of ERP introduction and diffusion with agricultural policy maker.*

### **1. Introduction**

Agricultural Products Processing Center (APC) is a key facility for agricultural products that have been established by specializing the production and distribution of agricultural products to strengthen market bargaining power and to increase the responsiveness of mountain regions according to rapidly changing agricultural environment. Since 1994, a full-scale support project for APC has been initiated with Distribution Reform Measure and Agricultural Structure Adjustment Project. As the establishment of a large-scale facility based on the Free Trade Agreement (FTA) implemented in 2004, it has become a new task to raise the utilization rate of the facilities and to improve the operational efficiency.

As a result, the ERP system was actively promoted to improve the accuracy, speed and efficiency of APC and to support management decision-making based on various information gathered from producing district and consumption site. Although 10 years have passed since the introduction of the ERP system in the agricultural sector, there is a noticeably lack of empirical research on the ERP system in the agricultural sector compared to other sectors. Especially quantitative performance verification through the introduction of ERP is insufficient. In addition, many managers agree on the necessity of introducing ERP for facilities over certain scale, but has contrasting views on effectiveness of actual introduction. Therefore, this research can give implication for those environments.

The purpose of this study is to provide implication for APC and policy maker by verifying increased work efficiency and return on investment (ROI) of ERP introduction. This study is composed of comprehensive arrangement including ERP system and APC and research background including ERP type classification, research methodology, analysis results and conclusions.

### **2. Research Background**

#### ***2.1. Enterprise Resources Planning***

ERP (Enterprise Resource Planning) system was first used by the Gartner Group, an information systems consulting firm in the United States. ERP system is defined collectively as conceptual and consultative concepts, but it is generally referred to an information system integrating and managing overall data related to business affairs such as finance, accounting, production, sales, inventory and personnel, etc. (Oh Jung Sook, 2001)

	<b>Definition</b>
Garter Group	The next generation business system as a set of applications that support business functions in the enterprise to work in harmony
The Weekly Economist	Business Reengineering maximizing productivity by consolidating and reorganizing various management resources such as manpower and fund in all business sectors of production, materials, sales, personnel and accounting
APICS (American Production & Inventory Control Society)	Total information system that supports the business of the company including the supply system from order to shipment and management accounting, financial accounting and personnel management using the latest IT technology

Table 1: Definition of ERP system

The development process of the ERP system began to develop in the 1970's MRP and the 1980's MRP II information system and to be actively built in the 1990s. In the late 1990s, it has evolved into an extended ERP that integrates CRM, SCM, and EC functions and integrally manages not only internal companies but also external resources surrounding the enterprise through open architecture.

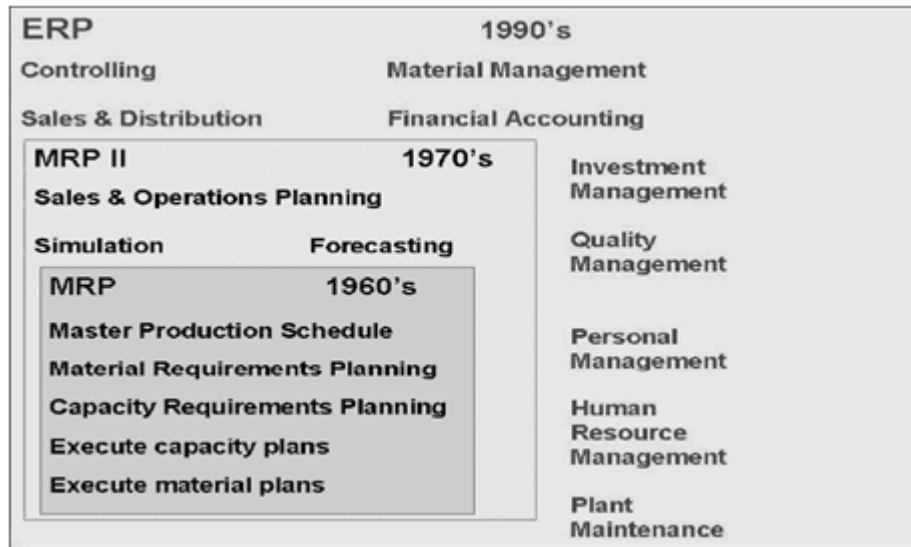


Figure 1: History of ERP system

The ERP system is recognized as a representative information system that integrates and manages all the resources of the enterprise and as having the potential to improve corporate performance (Hendricks et al. 2007). ERP system includes production management function as well as management support function and aims to implement integrated information system that makes optimal decision about upper and lower supply system such as customer or partner company in all business. Therefore, companies of introducing ERP system can maximize the profitability by reducing the purchase cost, cost and operating cost, minimizing inventory level, and improving the quality of customer service by increasing the sales (Jung Hyo Yang, 2002).

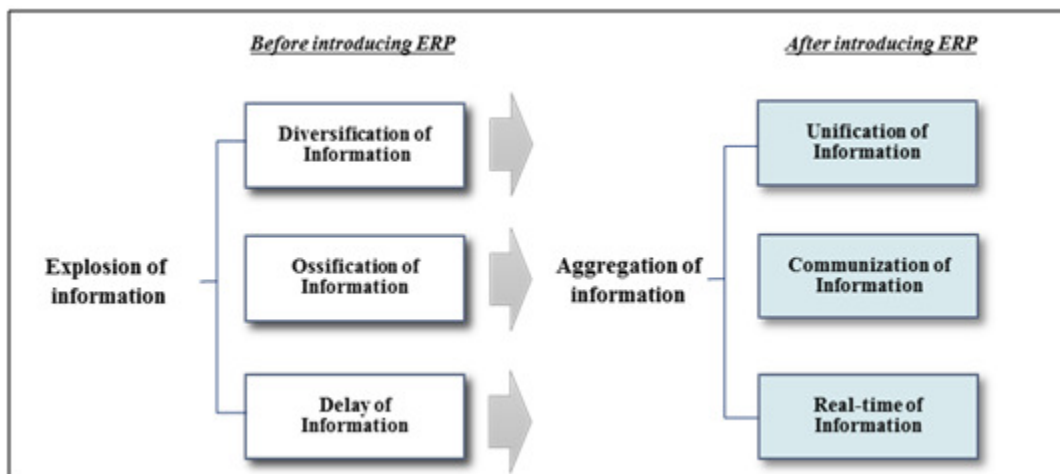


Figure 2: Characteristics of Information Flow in ERP system

### 2.2. Agricultural Products Processing Center

Agricultural Product Processing Center (Agricultural) is a key facility to enhance the commercialization value of agricultural products and to strengthen the marketing capability of the producing district by carrying out various functions such as collecting, cleaning, selecting, packing, storing and processing of agricultural products (Kim Sung Eun et al, 2011).

Since 1994, full-scale support project has been launched as part of the distribution reform measures and agricultural structure adjustment project. As the large distribution facilities based on the FTA in 2004 proliferate, the roles and functions of the APC have expanded and developed as shown in <Table 2> (Choi, Yangbu et al., 2000).

In spite of these various functions, however, problems related to the diffusion of facilities have also started to appear. It did not lead to efficiency of the facility due to the single item-oriented operation, facility idle period, and low operation rate. Also, many APCs are experiencing difficulties in management due to the lack of management capability, the lack of expertise and poor management as operator (Baek Seung-woo, 2007).

	<b>Function</b>
Agricultural products collection and procurement	<ul style="list-style-type: none"> <li>○ Extension for production (Propagation of a kind &amp; Agricultural Education)</li> <li>○ Co-production (Cooperative raising of seedling &amp; harvest of production)</li> <li>○ Production contract (Production contract &amp; Turnkey contract)               <ul style="list-style-type: none"> <li>- Variety, sow, harvest, cultivation condition &amp; Delivery time</li> </ul> </li> <li>○ Financial functions such as providing financial support</li> <li>○ Acquisition pricing</li> <li>○ Operating harvest agency</li> <li>○ Circular collection</li> <li>○ Sales settlement</li> </ul>
Product production management (Post-harvest management)	<ul style="list-style-type: none"> <li>○ Sorting &amp; Grading</li> <li>○ Standard packaging</li> <li>○ Processing (Washing, peeling, cutting etc.)</li> <li>○ Introduced technology to maintain quality such as pre-cooling and warming</li> <li>○ Cold storage</li> <li>○ Cold transportation</li> <li>○ Quality Management &amp; Food safety test</li> </ul>
Marketing & Sales Management	<ul style="list-style-type: none"> <li>○ Strategic Marketing Planning</li> <li>○ Environmental analysis &amp; market research</li> <li>○ Target consumers &amp; market settings</li> <li>○ Positioning strategy by differentiation</li> <li>○ 4P Management               <ul style="list-style-type: none"> <li>- Distribution channel management (Sales Planning and Sales Network Management)</li> <li>- Product management such as branding, new product development</li> <li>- Promotion management</li> <li>- Price level and pricing method</li> </ul> </li> </ul>
Distribution information & logistics management	<ul style="list-style-type: none"> <li>○ Electronic ordering using EDI</li> <li>○ Providing distribution information such as price and volume</li> <li>○ Introduction and utilization of shipment support system</li> <li>○ Pick-up and shipment using the pallet</li> <li>○ Internet sales through homepage</li> </ul>
Supply adjustment	<ul style="list-style-type: none"> <li>○ Production quantity control by producer serialization</li> <li>○ Supply and demand control through council or association</li> </ul>

Table 2: Distribution function of APC

### 2.3. Type of ERP system in APC

There are three main types of ERP systems introduced by APC. First, full-packaged type is a system that manages the entire APC business process as an ERP system. Full packaged type has the advantage of being able to implement the system that is optimized for APC items and work types, but it has a disadvantage that the initial phase construction cost is high. In addition, the second ERP system type is cooperative grading type. The government's policy direction on the distribution of agricultural products focus on securing the sustainability of farm income through cooperative selection and cooperative calculation. The system is an efficient system for the performance management required by the government, but there is a limitation that it cannot be applied to the system other than cooperative selection and cooperative calculation. Third, a financial management type ERP system is a monthly payment system developed in common for managing APC. This system has high financial management efficiency, but it has limitations that it cannot bring the process of commodification into system. In this study, the effects of ERP introduction was analyzed for the above three types, and the investment return analysis of the ERP system by type was conducted for the representative APC utilizing the full packaged type and cooperative grading type.

#### *2.4. IT Performance Analysis Methodology*

IT performance analysis can be divided into three categories. First, quantitative analysis means analyzing the correlation between information system investment and firm performance and measuring performance as monetary value. However, when using only quantitative analysis method, it is difficult to reflect the non-quantitative effect. Second, the qualitative analysis method analyzes the IS effect measurement index to individuals. However, the qualitative analysis method is limited to the effects of the individual level and has a limitation that the effect on the investment cost is not considered. Third, IT-BSC analysis method presents IT investment evaluation index as BSC. . Although having an advantage that both quantitative and non-quantitative indicators can be considered at the same time, researchers it has limitations that researchers set arbitrary models and the empirical research verification is weak(Jeong et al.,2005). In this study, we try to derive the effect of introduction of information system on various aspects by simultaneously verifying the qualitative analysis method and the profit effect of investment cost.

#### *2.5. IT Investment Return Analysis Methodology*

There are Cost-Benefit Analysis, TOC (Total Cost of Ownership), and Total Economic Impact methodology in the IS investment return analysis. First, Cost-Benefit Analysis aim at supporting decision-making to invest a given budget. And it is a method of comparing the investment cost and the effect of investment. Although there is an advantage of deriving financial effects, it has limitations that do not take in to account the costs and effects already incurred. Second, TCO model is a method of analyzing the cost of information system management, which has the advantage of not only visible but also hidden cost. However, information systems have limitations in approaching problems only on the cost side. Third, the total economic effect can produce not only the financial effect but also the strategic effect, but it is difficult to quantify the non-financial effect (Kim et al., 2006). In this study, we analyzed the return on investment (ROI) by introducing APC's ERP using Cost-Benefit analysis and TCP analysis.

### **3. Research Methodology**

#### *3.1. Analysis of ERP Introduction Effect*

The effect of introducing ERP was investigated by 31 practitioners of 7 APCs who introduced ERP system. 8 are using full-packaged ERPs, 5 are public employees, and 18 are financial managers. A structured questionnaire with a Likert 5-point scale distributed as a survey method, and a survey was conducted by mail or e-mail. Investigating items is 10 such as satisfaction level of system introduction, degree of professional improvement, goal sharing, standardization of work, usefulness of system introduction, improvement of reliability among members, improvement of work efficiency, strengthening accountability, organizational democracy, and decision making efficiency. In addition, the degree of improvement in work efficiency quantitatively answered by the degree of efficiency improvement of practitioners using ERP. The descriptive statistics analyzed by full-packaged type, cooperative grading type, and financial management type.

#### *3.2. Analysis of ERP Investment Return*

The analysis of the investment return on APC's introduction of ERP conducted through in-depth interviews with one center CEO adopting a full-package type and one center CEO adopting a cooperative grading type. Financial analysis items following ERP introduction are divided into cost analysis and benefit analysis. Cost items classified into direct costs and indirect costs, and performance items classified into type performance and intangible performance. Through this, ROI (Return on Investment), PP (Payback Period) and Discounted Payback Period (DPP) were derived.

### **4. Results**

#### *4.1. Analysis of ERP Introduction Effect*

Table 3 shows the analysis results of the effect of introducing ERP system by type of APC. The full-packaged type showed a 21.3% improvement in work efficiency. In terms of items, satisfaction, goal sharing, job specialty, job responsibilities, and decision - making democracy were high. Work efficiency of cooperative grading type improved by 42.0%. Because those ERP was built around the settlement related work of the farmers shipped to the APC, they did not feel much help in the business standardization. In the financial management type, work efficiency improved by 15.0% and lower than the average level in all items. This is because ERP designed according to South Korea government's policy is more qualitatively effective than simple management type ERP.

	Satisfaction	Goal sharing	ERP Utility	Work Efficiency	specialty improvement	Work Standardization	Member reliability	Strengthen accountability	Democracy	Decision-making efficiency	Work efficiency improvement
Full-packaged	3.75	3.44	3.25	3.33	3.50	3.25	3.31	3.38	3.44	3.25	21.3%
Cooperative Grading	4.60	3.80	3.80	3.87	4.20	3.20	4.20	3.40	4.00	4.20	42.0%
Financial Management	3.33	3.00	3.08	3.11	2.89	3.11	3.11	3.11	2.97	3.17	15.0%
Whole average	3.65	3.24	3.24	3.29	3.26	3.16	3.34	3.23	3.26	3.35	21.0%

Table 3: The effects of ERP adoption

#### 4.2. Analysis of Return on Investment (ROI) by ERP Type

##### 4.2.1. Full-Packed ERP System

The initial implementation cost of the full-package ERP system was KRW 100 million, and maintenance costs were estimated to be KRW 10.5 million annually. Since the project conducted through an external professional ERP builder, the additional costs incurred by contracting and operating the company are KRW 1,080,000 / year. In sum, the cost incurred by adopting full-packaged ERP is 111,580,000 won.

[Unit: Korean Won]		
Total Cost of Ownership	Costs	Detailed Costs
<b>Direct Costs</b>	<b>₩100,000,000</b>	
Labor costs		₩100,000,000
<b>Temporary Indirect Costs</b>	<b>₩0</b>	
Capital costs (Asset purchase costs)		₩0
<b>Continuous Indirect Costs</b>	<b>₩11,580,000</b>	
Education, Maintenance and Support costs		₩10,500,000
Operation and contract costs		₩1,080,000
Other costs		₩0
<b>Total Costs of Ownership</b>	<b>₩111,580,000</b>	<b>₩111,580,000</b>

Table 4: Total Costs of Ownership of Full-Packed ERP system

The effect of type of full packaged ERP is labor productivity improvement, asset cost reduction, process productivity increase, business effect, and total tangible effect is 22,665,000 won per year. The intangible effect found to have competitive advantage and intellectual asset effect, while the intangible effect totaled 31,553,400 won per annum. The total benefit of combining tangible effects and intangible benefits is 54,209,400 won per year.

[Unit: Korean Won]		
Benefit Driver	Benefit	Benefit Detail
<b>Tangible Benefits</b>	<b>₩22,665,000</b>	
Improve labor productivity		₩3,840,000
Asset cost savings		₩0
Increase process productivity		₩13,824,000
Business Effect		₩4,992,000
<b>Intangible Benefits</b>	<b>₩31,553,400</b>	
Brand advantage		₩0
Competitive advantage		₩27,737,640
Strategic advantage		₩0
Intellectual property		₩3,815,760
<b>Total cumulative net benefit</b>	<b>₩54,209,400</b>	<b>₩54,209,400</b>

Table 5: Benefit Drivers of Full-packaged ERP system

As a result of ROI (Return on Investment) analysis based on the introduction of full packaged ERP, ROI exceeded 100% between 5 and 6 years after the introduction of ERP.

	Introduction year	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8
ROI	-	28.1%	50.3%	68.3%	83.1%	95.5%	106.1%	115.1%	123.0%

Table 6: Return on Investment of Full-Packaged ERP System

When the full-packaged ERP introduced, payback period was 5.77 years. The payback period, which reflects 4.01% of the Bank of Korea's economic statistics system corporate bond revenue at a discount rate, was 6.34 years.

Breakeven Point	
Payback Period, Year	5.77
Discounted Payback Period, Year	6.34

Table 7: Payback Period of Full-Packaged ERP System

#### 4.2.2. Cooperative Grading ERP System

The initial cost of cooperative grading ERP implementation is KRW 10,500,000. The initial cost of the ERP implementation is KRW 10,500,000. Since it proceeds through the external professional ERP builder, the additional cost of contracting and operating the company is KRW 50,000 / year.

[Unit: Korean Won]

Total Cost of Ownership	Costs	Detailed Costs
<b>Direct Costs</b>	<b>₩10,500,000</b>	
Labor costs		₩10,500,000
<b>Temporary Indirect Costs</b>	<b>₩0</b>	
Capital costs (Asset purchase costs)		₩0
<b>Continuous Indirect Costs</b>	<b>₩50,000</b>	
Education, Maintenance and Support costs		₩0
Operation and contract costs		₩50,000
Other costs		₩0
<b>Total Costs of Ownership</b>	<b>₩10,550,000</b>	<b>₩10,550,000</b>

Table 8: Total Costs of Ownership of Cooperative Grading ERP system

Tangible effects introduced by the ERP system was to increase labor productivity and process productivity, and the sum of tangible effects was 5,040,000 won / year. No intangible effects occurred.

[Unit: Korean Won]

Benefit Driver	Benefit	Benefit Detail
<b>Tangible Benefits</b>	<b>₩5,040,000</b>	
Improve labor productivity		₩1,080,000
Asset cost savings		₩0
Increase process productivity		₩3,960,000
Business Effect		₩0
<b>Intangible Benefits</b>	<b>₩0</b>	
Brand advantage		₩0
Competitive advantage		₩0
Strategic advantage		₩0
Intellectual property		₩0
<b>Total Cumulative Net Benefits</b>	<b>₩5,040,000</b>	<b>₩5,040,000</b>

Table 9: Benefit Drivers of Cooperative Grading ERP system

As a result of return on investment (ROI) analysis based on the introduction of cooperative grading type ERP, ROI exceeded 100% between 3 and 4 years after ERP implementation, and the return from the investment occurred.

	Introduction year	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8
ROI	-	27.6%	53.8%	78.9%	102.7%	125.5%	147.2%	168.0%	187.8%

Table 10: Return on Investment of Grading ERP System

Payback period of cooperative grading type ERP was 3.53 years. Payback period, which reflects 4.01% rate of return on the Bank of Korea's economic statistics system cooperative bond, was 3.88 years.

**Breakeven Point**

Payback Period, Year	3.53
Discounted Payback Period, Year	3.88

*Table 11: Payback Period of Grading ERP System***5. Conclusions**

The purpose of this study is to support decision making of ERP adoption and choice of ERP type by presenting the effect and investment feasibility of adopting ERP system in agricultural sector.

ERP system can be classified into three types according to the application range of the APC. First, there is a full packaged type ERP managing the whole process. Second, to respond to cooperative selection and cooperative calculation, which is the direction of Korea Government's distribution policy, there is a cooperative grading type ERP managing only those sectors. Third, there is a financial management type ERP that commonly used to manage the financial sector.

This study can be divided into two major categories. First study examines the effect of ERP implementation on APC practitioners who have implemented ERP systems. The purpose of this study was to identify different effects of each item by investigating 10 items such as satisfaction and usefulness of ERP introduction. As measuring the degree of improvement of work efficiency by ERP introduction, we also tried to find out what type of ERP increased the work efficiency. In summary, APC practitioners who introduced cooperative grading type ERP in the majority of items showed a high response rate, the degree of improving work efficiency was 42.0%. In the case of full packaged type ERP, it was higher than total average in five items and work efficiency was 21.3% higher after the introduction of ERP. In financial management type ERP, the range of system services is limited, so the responses of 10 items are lower than the average.

Second study derives ROI by extracting each one representative case of APC that adopts full packaged type and cooperative grading type ERP. Full-packaged type ERP is 5.77 years, and a 6.34-year payback period occurs when considering the discount rate. Cooperative grading type ERP is 3.53 years, and a 3.88-year payback period occurs when considering the discount rate. Investment return analysis by ERP type will help judge which type of ERP is appropriate to introduce ERP.

As the effect of APC's introduction of ERP derive the return on investment, this study can contribute to establish a theoretical foundation for future research. Second, as providing basic information to judge introduction type, this study can contribute to increase the decision-making easiness for farmers. Third, as it is proved that ERP system contributes to increase work efficiency, policy maker will be able to utilize this study as the basic data for the policy diffusion of ERP.

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**7. References**

- i. Baek Seung Woo, Jang Dong Heon and Lee So Young(2007), "A Study on the Analysis of Efficiency in APC", Korean Journal of Food Marketing Economics, 24(2), 1598-9925.
- ii. Choe Yang Boo and Kim Dong Hwan (2000), "A Study on Characteristics and Functions of Agricultural Products Processing Centers", Korean Journal of Food Marketing Economics.
- iii. Choe Young Chan and Moon Jung Hoon(2003), "Strategies for Information Requirements Analysis for Agricultural Management Information System Developments", Journal of Agricultural Extension & Community Development, 10(1), 1-14.
- iv. Choi Hyun Dol and Lee Jang Hyung (2005), "A Study on the Accounting Transparency Financial Characteristics between ERP Systems Implementation and Non Implementation Companies", the Journal of Information Systems, 14(1), 107-124.
- v. Ha Byoung Yun (2001), "The effect of enterprise resource planning (ERP) system on a business performance" Chung-Ang University.
- vi. Hendricks, Kevin B., Vinod R. Singhal and Jeff K. Stratman(2007), "The impact of enterprise systems on corporate performance: A study ERP, SCM, and CRM system implementations", Journal of Operations Management, 25(1), 65-82.
- vii. Hong Jung Hwa and Lim Chai Eun (2006), "A Study on the Implementation Result of ERP System by Productivity Index", International Journal of Business and Management, 20(2)
- viii. Hunton, James E., Barbara Lippincott and Jacqueline L. Reck(2003), "Enterprise resource planning systems: comparing firm performance of adopters and nonadopters", International Journal of Accounting Information Systems, 4(3), 165-184.
- ix. Jung Hyo Yang (2002), "An Empirical Study on user performance of ERP systems: 12 Korean companies", Department of Information Administration, The Graduate School of Industrial Management, Chung-Ang University
- x. Kim Jung Chan and Roh Hyun Sub (2007), "An Analysis on the Firms" Financial Performance of ERP System Implementation", Korean Journal of Accounting Research, 12(3).
- xi. Kim Sung Eun and Kim Jin Suk (2011), "A Study on the Operational Efficiency of APC", Journal of Agriculture & Life Science, 45(5), 127-143.
- xii. Kim Tae Ung and Nam Yong Sik (2000), "A Study on the Implementation Strategy and Performance of Enterprise Resource Planning System in Korean Manufacturing Firms", Asia Pacific Journal of Information Systems, 10(1), 61-79.

- xiii. Kim Young Woon and Chong Ki Won (2006), "A Study on Methodology to Assess IT Investment by ROI", the Journal of Society for e-Business Studies, 11(1)
- xiv. Lee Jang Gun, Jung Yong Ki and Heo Bong Koo (2009), "Financial Analysis of the Effect of the ERP System Implementation and the Productivity Paradox", Accounting Information Review, 27(1), 231-259.
- xv. Matolcsy, Zoltan P., Peter Booth and Bernhard Wieder(2005), "Economic benefits of enterprise resource planning systems : some empirical evidence", Accounting and Finance, 45(3), 439-456.
- xvi. Na Young and Jin Dong Min (2006), "An Empirical Research on the Performance of ERP Implementation and the Market Value of the Firm", Accounting Information Review, 24(4), 99-121.
- xvii. Na young, Jang Jee In and Park Mun Gi (2000), "Financial Performance Effect of ERP Building on the company", Korean Journal of Business Administration, 24, 305-348,
- xviii. Oh Jeong Sook (2001), "IT Industry Trends: Software", Korea Information Society Development Institute, 23-36
- xix. Poston, Robin and Severin Grabski(2001), "Financial impacts of enterprise resource planning implementations", International Journal of Accounting Information Systems, 2(4), 271-294.
- xx. Yeon Jun Mo(2009), "A study for activation plan to agricultural product processing", Dept. of Business Administration, The Graduate School Of Government and Business, Yonsei University, Master degree.
- xxi. Yoo Chul Woo, Park Soo Min, Choe Young Chan and Shim Gum Seop (2009), "Success Factors for Web-based Agricultural Information Systems", Journal of Korea Society of Rural Planning, 15(4), 59-74.