Conference Paper

Traceability Costs in Agro-Industry

Jomsurang Chumsai na Ayutthaya and Thanit Puthpongsiriporn

Department of Agro-Industrial Technology, Faculty of Agro-Industry, Kasetsart University 50 Ngamwongwan Rd. Lad Yao, Chatuchak, Bangkok 10900, Thailand

Abstract

More food business operators start to look into "traceability" as an essential tool to boost the confidence level in their products. A question commonly asked by those who are considering implementing a traceability system is "how much does it cost." This research aims to estimate the investment and operating costs of traceability systems. Cost of Quality is used to exam the overall price by dividing expenses into prevention, appraisal and correction costs. This article presents results from examinations of four business establishments. Preliminarily, the average total traceability cost is approximately 0.7 million baht per year which is a small fraction compared to sales. Major contributors to the overall cost are data collecting activities, operating, training and education, and hardware & software related costs, respectively. Results from this study could be useful for business operators considering acquisition or developing of traceability system.

Keywords: Traceability; Cost; Cost of Quality; PAF Model

Corresponding Author
Thanit Puthpongsiriporn
Thanit.p@ku.ac.th

Received: 25 December 2017
Accepted: 5 February 2018
Published: 1 March 2018

Publishing services provided by Knowledge E

Selection and Peer-review under the responsibility of the ICoA Conference Committee.

INTRODUCTION

Traceability is the ability to access any or all information about a product along the supply chain by systematically recorded identifications. [3] Traceability allows remedial activities (such as product recalls) to be carried out in a timely manner and effectively for the unexpected situations. [4] When an authorized agency detected a potential food safety issue, traceability plays an essential role in precluding unsafe products from reaching consumers. With increasing requirements in import/export regulations along with global trends on product safety and consumer health concerns, more business operators start to realize the significance of product traceability. To tip business owners' decisions toward investing in such ability, one important question "how much does it actually cost" must be answered. Amongst others, the magnitude of a traceability investment can rely on the controlling nature such as firm policy, company size, the technology of each business, features of products and production processes, supply

chain structural and difficult of the management and the demand of information for storage. [2] This research aims to provide empirical data regarding initial and operating costs of traceability systems from four business establishments.

Costs of traceability can be separated into five categories including 1) time & effort 2) certifications & audits 3) external consultants 4) equipment & software 5) materials [1]. However, many expenses associated to traceability are not explicitly recorded. One hardly knows exactly how much traceability is. To be able to estimate the total cost, activities related to traceability must be identified and appraised systematically.

METHODOLOGY

1. Classify traceability related activities based on Asioli's five categories of traceability costs.
2. Collect data from four business establishments
3. Analyze and compare traceability costs

RESULTS AND DISCUSSION

Classify traceability activities

According to Asioli's suggestions, traceability work can be classified into five groups including:

1. Time & Effort costs incurred from traceability planning and data collection tasks.
2. Certification & Audit costs resulted from internal and external training & auditing and suppliers verification activities
3. External Consultant costs in the case that the establishment doesn't have resident traceability expert(s) to carry out developing and implementation of the system.
4. Equipment & Software costs such as software and hardware cost.
5. Materials which are maintenance, office equipment costs and electricity bills.

In this research, labor costs incurred by traceability related activities in any cost category are estimated using the following formula:

$$LC = N \times R \times H \times F$$

where *LC* is the labor cost; *N* is number of staff with the same pay rate involved in the activity; *R* is the hourly pay rate based on staff's wage or salary; *H* is the number of hours required to finish the task; *F* is the average occurring frequency of such activity in a month

Equipment or investment costs are allocated based on five year depreciation with zero salvage value.

Maintenance, repair, and operational (MRO) costs as well as utility bills are interpolated based on the proportion of man- hour spent in traceability related activities to the total man-hour available.

Table 1 shows examples of labor, equipment, and MRO cost calculations used in this research.

Table 1: Examples of traceability labor, Equipment, and MRO costs used in this research.

Activity	Description	Cost Calculation
Time & Effort		
- System planning	**(Animal feed manufacturer)** A meeting is held once a month and lasts for two hours. Attendees includes: + one executive manager with a salary rate of $20.31/hr., + four managers from the purchasing and sales dept. together with an average pay rate of $7.11/hr., + one accounting supervisor @ $2.71 /hr., + five representatives from purchasing, production, warehouse, shipping, and HR departments @ $2.03/hr. (avg.)	1 × $20.31/hr. × 2 hr. × 1/m. = $40.62/m. 4 × $7.11/hr. × 2 hr. × 1/m. = $56.88/m. 1 × $2.71/hr. × 2 hr. × 1/m. = $5.42/m. 5 ×$2.03/hr. ×2 hr. ×1/m. = $20.3/m.
	Total system planning expenses	**$123.22/m.**
- Data collecting	**(Drinking water producer)** The warehouse manager usually spends an hour on keying data into Microsoft Excel worksheets and has an average compensation rate at $2.37/hr. Also, a purchasing staff and a delivery staff each put in an hour on digitizing data daily. Both has an average hourly rate of $1.22/hr.	1 × $2.37/hr. ×1 hr. × 26/m. = $61.62/m. 2 × $1.22/hr. × 1 hr. × 26/m. = $63.44/m.
	Total data collecting expenditures	**$125.06/m.**
Certification & Audit		

Activity	Description	Cost Calculation
- Internal and External training	**(Animal feed manufacturer)** Three staff from purchasing, production and warehouse department participate a training twice a month. Each session takes the whole day. Their average payment rate is $1.63/hr. In addition, each training has an approximated cost of $42.25.	3 × $1.63/hr. × 8 hr. × 2/m. = $78.24/m. $42.25×2/m. = $84.50/m.
	Total Internal and External training cost	**$162.74/m.**
- Internal auditing	**(Animal feed manufacturer)** Six employees from sales, purchasing, production, warehouse, delivery and accounting departments perform monthly audit on traceability data. Each spends approximately an hour on the task and their average hourly rate is $1.63/hr.	6 × $1.63/hr. × 1 hr. × 1/m. = $9.78/m.
- External auditing	**(Animal feed manufacturer)** On average the company prepares for customer auditing four times a year (0.33/m.). Each takes an entire day. An executive manager and ten supervisors from the sales, purchasing, planning, production, warehouse, delivery, QA/QC, IT, accounting, and HR departments with an average pay rate at $4.31/hr. must attend the event.	11 × $4.31/hr. × 8 hr. × 0.33/m. = $125.16/m.
- Suppliers checking	**(Animal feed manufacturer)** Two supervisors from the sales and delivery dept. Validate suppliers twice a year ($0.17/m.) and spend three hours each time. Together their monthly wage equals to $2.71/hr.	2 × $2.71/hr. × 3 hr. × 0.17/m. = $2.76/m.
External Consultant		
- External Consultant	**(Organic produce vertical integrator)** A consultant is hired at $35.21/hr. for 8 hours each month to give consults on improving the company's traceability.	1 × $35.32/hr. × 8 hr. × 1/m. = $282.56/m.
Equipment & Software		
-Software	**(Pork processor)** The company pay a monthly fee of $845 for a POS and stock software.	1× $845/m. = $845/m.

Activity	Description	Cost Calculation
- Hardware	An electronic scale, a barcode printing and a barcode reading device require an investment of $985 assuming five-year depreciation with zero salvage value.	$985 ÷ 5 ÷ 12= $16.42/m.
Materials		
- Office equipment cost	**(Drinking water producer)** The documents and office supplies cost $85/m.	1 × $85/m. = $85/m.
- Electricity bill	The estimate of power consumption for the traceability activities is estimated to $228/m.	1 × $228/m. = $228/m.

Data collection

Four establishments participated in this research includes animal feed manufacturer, drinking water producer, organic produce vertical integrator, and pork processor.

Animal feed manufacturer: is a medium side importing, producing, and locally distributing animal feeds and feed supplements. The company is expanding its market to surrounding countries of Thailand and is part of a holding which is the second largest feed producer in the country.

Drinking water producer: produces bottled drinking water under its own brand and as OEM's for many leading wholesale chains in Thailand. Many of their "high-end" hotel, hospital, department store, and restaurant customers require rigorous quality control and quality assurance.

Organic produce vertical integrator: owns approximately 19.2 hectors of organic rice paddy, organic vegetable farm, and organic fresh water fish ponds. Also, the company operates one rice milling facility, one food processing factory and 22 retail shops. Proving evidence for their products' organic authenticity from farm to shop involves a great amount of data collection through the entire supply chain.

Pork processor: is a pork butchering shop located in a southern province of Thailand whose primary products are made-to-stock and made-to-order cuts of pork. They also offer processed pork products including Chinese pork sausages and pork meat balls.

Their retail facility utilizes a point-of-sale (POS) system that integrates an electronic scale with a cash drawer and manages product stock.

Table 2: Traceability cost breakdown of the four business establishments.

Activity Cost	Four Business Establishments				Average
(USD @35.5THB/USD)	Pork Product	Organic Produce	Drinking Water	Animal Feed	
1. Time & Effort					
- System planning	22	29	40	123	
- Data collecting	150	1,107	125	195	
Total/month	172	1,136	165	318	540
Total/year	2,067	13,630	1,975	3,819	**6,475**
Percent average	9.64%	64.37%	12.19%	26.12%	**35.27%**
2. Certifications & Audits					
- Internal and External training	87	23	175	163	
- Internal auditing	43	-	92	10	
- External auditing	-	-	88	126	
- Suppliers checking	4	-	39	3	
Total/month	134	23	394	301	213
Total/year	1,603	278	4,732	3,616	**2,558**
Percent average	7.48%	1.31%	29.21%	24.73%	**15.68%**
3. External Consultants					
- Consultants/Programmers	423	282	423	282	
Total/month	423	282	423	282	352
Total/year	5,070	3,380	5,070	3,380	**4,225**
Percent average	23.65%	15.97%	31.30%	23.12%	**23.51%**
4. Equipment & Software					
- Software	845	47	56	56	
- Hardware	16	-	-	5	
Total/month	862	47	56	62	257
Total/year	10,338	563	676	738	**3,079**
Percent average	48.23%	2.66%	4.17%	5.05%	**15.03%**
5. Materials & Utilities					
- Office equipment cost	28	85	85	85	
- Electricity bill	168	192	228	171	
Total/month	196	277	312	256	260
Total/year	2,358	3,322	3,744	3,070	**3,123**
Percent average	11.00%	15.69%	23.12%	20.99%	**17.70%**
Total cost/month	1,786	1,764	1,350	1,219	1,530
Total cost/year	**21,436**	**21,173**	**16,199**	**14,624**	**18,358**
Sales/year (Mil. $)	**1.014**	**3.944**	**4.789**	**1.014**	
Total cost as percent of sales	**2.1%**	**0.5%**	**0.3%**	**1.4%**	**1.1%**

The company plans to launch a new product, premium Chinese pork sausages, to Malaysian markets close to the border.

The researcher team interviewed owners, managers, and operators in participating companies. Table 2 shows traceability cost breakdown of the four business establishments.

Analyze and compare traceability cost

The average total traceability cost from four business establishments investigated under this research is $18,358/yr. Animal feed manufacturer has the lowest total annual cost at $14,624, while Pork processor spends the most at $21,436 per year.

Comparing five categories of traceability costs, system planning and data collection activities together with external consultant expenses co- contribute to almost 60% of the average annual total cost (35.27% and 23.51%, respectively). The other three cost categories cause the rest of the annual total cost at almost equal weight.

Considering each business separately, pork processor came in first in terms of total annual traceability expenses at $21,436. This is due to its very high equipment and software cost at $10,338/yr. for its POS and stock management system which is 3.4 times higher than the average and 18.4 times higher than the minimum expenditure in the same category. However, pork processor has the lowest traceability costs in the Time & Effort and Materials & Utilities categories.

Organic produce vertical integrator spends the second highest total traceability cost due to its exceptional data collection cost which is approximately 64.37% of its total traceability cost and is 2.3 times to the average and 6.7 times to the minimum amount. This could be resulted from three factors including: 1) the head office is the only party who is responsible for entering all data from farm to shops into its database, 2) complying to high international standard documentation requirements amplify the cost, and 3) the company may have to compensate for its relatively lower hardware & software investment cost with higher labor costs.

However, comparing the total annual traceability cost of each company to its annual sales shows that the average total cost as percent of sales is 1.1%. Pork processor has the highest ratio at 2.1%

And drinking water producer has the lowest percentage at 0.3%.

CONCLUSION

This paper studies cost of traceability systems in four agro-industry businesses. Data were collected through interviews with owners, managers, and operators in those

establishments. Expenses related to traceability are categorized into five groups. Results show that the average total cost is approximately $18,358 per year which is a small fraction compared to the annual sales. Major contributors to the overall cost ranked from the most costly to the least are data collecting activities, external consulting fees, material & utility expenses, equipment & software investment, and certifications and audits, respectively. However, costs proportions of five categories vary among four businesses under investigation due to different nature of each firm. Results from this study provide a guideline in terms of costs associated to traceability for those who are considering acquiring or improving own traceability. Also, reported data could provide a simple benchmark for those in the same lines of businesses.

ACKNOWLEDGEMENT

This research is a part of The 2016 Food Product Hygienic Reliability Improvement for Asia and EU Import project, which is supported by the Bureau of Logistics, Department of Primary Industries and Mines, Ministry of Industry of Thailand.

References

[1] Daniele Asioli, Andreas Boecker, and Maurizio Canavari. 2011. Perceived Traceability Costs and Benefits in the Italian Fisheries Supply Chain. Int. J. Food System Dynamics 2(4), 2011, 357–375

[2] Food Standard Agency, UK (2002) Retrieved from www.food.gov.uk/ multimedia/pdfs/traceabilityinthefood chain.pdf (Accessed 15.07.12)

[3] Giuseppe Aiello, Mario Enea and Cinzia Muriana. 2015. The expected value of the traceability information. European Journal of Operational Research 244 (2015) 176 – 186

[4] S. Pouliot, D.A. Sumner Traceability, liability, and incentives for food safety and quality American Journal of Agricultural Economics, 90 (2008), pp. 15–27