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Potential Application of A Quality Cost Model for Fresh Produce Packhouses

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Abstract

The objective of this research is to access the potential of a quality cost model to food industry as a quality improvement indicator tool. The quality cost model has been applied for salad pack house and selenium egg pack house. The primary cost analysis show the different proportionality between cost of prevention and cost of control among two types of manufactures. Such evidence is explained by the different risk of products; fresh ready to eat vegetable and the raw egg in shell, thus the different of working model. The cased manufacturers indicated the possibility to apply this cost model as a long term quality improvement evaluation tool in term of the quality cost investment and the business revenue growth.

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Keywords: Quality cost; egg packhouse; salad packhouse; HACCP

1. Introduction

Good manufacturing practice (GMP) and HACCP are food safety techno-managerial tools widely implemented in order to assure the compliance of food products. According to the survey studied by Henson et al. (1999), most of the dairy companies in UK implement HACCP because of the legal registration. Such results also repeated in the study of HACCP implementation in Thai food manufacturers (Waisarayutt et al., 2014)

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To help the manufacturers' relief for the benefit of quality management application, the quality cost model is a promising tool. With the quality cost structure, that divides the total cost into cost of prevention, prove and control and cost from non-compliance product. This cost model can be used as a recording platform and provide the further information of the quality system efficiency as a project time line. The objective of this research is to evaluate for the potential of introducing the cost model to food manufacturers as an quality management evaluation tool using two cases of salad (Petkeaw, 2013) and Selenium egg packhouse (Pangwiset, 2014). The quality cost data used as quality improvement indicators also are discussed.

2. Literature reviews

PAF model is a quality-related cost for evaluating cost of quality (Feigenbaum, 1974) which is classesd into four parts: prevention cost, appraisal cost, internal failure cost, and external failure cost. Preventive cost is direct to quality assurance activities while appraisal cost is related to process or product validation in quality control activities. Both internal and external failure cost focus on defects of processes. (Zugarramurdi et al., 2007)

2.1. Preventive costs

2.1.1. Prevention costs

Prevention costs are composed of four issues which are considered in food processing. The first issue is point out planning of quality system establishment activities such as designing, developing, and implementing of quality assurance plans. Planning activities of prevention always relates to measurement and tools for detection. The second issue is training program for personal and suppliers that will influence to sampling plan. The third issue mentions on sanitization and hygiene of production environment that decrease contamination across the processes. And the last issue considers for maintenance and additional supervision to keep quality system consistently. (Huss, 1994; Zugarramurdi et al., 2007)

2.1.2. Appraisal costs

Appraisal costs are costs of quality inspections and tests. In order to ensure the reliability of processes, the activities those mostly relate to the costs begin with raw materials, in-line processing, and quality controls. The beginning of appraisal cost is acceptance of material incoming procedures that determine specification and requirement of raw materials. Next activities are quality control which is performed by laboratories. The in-line inspection, as well as, is included into this cost by verifying at critical control points. (Hubburd, 1996; Zugarramurdi et el., 2007)

2.2. Failure costs

2.2.1. Internal failure costs

Internal failure cost relates to organization performances and management such as failures in processing, idles of time and labors, and reprocessing. This cost is declared into three issues that the first is defections along the productions with spoilage or shrinkage which are lost or reprocessed. After issues are focused on idles that causes of waste expenses. Finally, the issue in inefficiency usage is significant that is result of poor inputs. (Zugarramurdi et al., 2007)

2.2.2. External failure costs

These failures are indicated by claims and recall that occur at customers. It is the related appraisal costs by exponential function. (Zugarramurdi et al., 2007)

Cost of Quality is not only used in food industry but the laboratories are also. Following the study of Elbireer et al. (2010) collected Makerere University-Johns Hopkins University (MU-JHU) Laboratory data in Uganda from January to December 2007. They categorized into two subgroups those are Cost of good quality and Cost of poor quality. Moreover, the analysis is showed both stage of laboratory process and categories in PAF model. They found that 94% of expense cost is preventive cost and 6% for failure cost. It also refer to benefit of PAF model as the optimal for economic evaluation to be a tool for developing high quality outcome

HACCP is also implemented to airline catering for improving hygiene status, operational processes and experience of employees. The improvement consists of temperature monitor devices and maintenance devices. In the case study performed in consulting cost and personnel cost as a HACCP plan development. Cost of improvement of GHP, training cost, and Cost of HACCP requirements are cost of HACCP plan implementation and HACCP maintenance cost as well as HACCP certification cost are considered also. The total cost is €103,862.13. (Bata et al.,, 2006)

The recent food management is not only quality system development but integration of management is also integrated along the process. By survey review of (Dora et al., 2013) finding SMEs implement FQMS in European. The benefits are also identified and barriers of implements are shown. The important indication of customer loyalty is concerned in issue of Quality compliance with the marketing strategy of SMEs that potentially tend to Quality issue also. The significant method of quality improvement is Dashboard approach but Lean strategy is potential to use as a tool recently. Finally, barrier of improvement is lack of quality design experience which should be support to SMEs business.

3. Methods and results

3.1. *PAF cost model*

PAF cost model classes the total cost into two subgroups which are the cost from prevention (P) and appraisal (A) for the preventive effectiveness and the cost associated with failure occurring either within the manufacturer (Internal failure cost, IF) or outside the manufacturer (External failure cost, EF) in the market place.

With this study two subgroups cost model structure, the information reflects the correlation between preventive investment cost and the failure cost. We expect the compensation between these two subgroup costs. Table 1 concludes for the PAF quality cost list.

Table 1, PAF cost model list

Conformance cost	Non-conformance cost
Prevention cost (PC_i)	Internal failure cost (IF_i)
PC_1: design, implement assurance plan	IF_1: reprocessing
PC_2: planning program	IF_2: Low labor productivity
PC_3: sanitation	
PC_4: preventive maintenance	
Appraisal cost (AC_i)	External failure cost (EF_i)
AC_1: Control for raw material	EF_1 : claims, recalled products
AC_2: Sampling and analysis	
AC_3: in-process control	

3.2. *Case study Salad packhouse and Selenium egg packhouse*

The model of this study presents the premium agricultural products: Vegetable salad and Selenium egg, that packhouses are established GMP and HACCP as the quality system. The Vegetable salad is processed by The Royal project foundation and Selenium egg is nutrition added products which are also sized for high ended products. They implemented the PAF for cost model and compared for the proportion of prevention cost, appraisal cost and failure cost

3.2.1 Vegetable salad case

The recorded forms are implemented in The Royal Project Foundation in order to establish GMP and HACCP system from January to December of 2012 indicated for twenty four of quality activities included by eight activities of prevention cost and sixteen activities for appraisal cost.

3.2.2 Selenium egg case

The establishment of GMP and HACCP in 2013 of Selenium egg packhouse are reported that recorded forms are also able to indicate the cost of quality into prevention cost and appraisal cost. Both vegetable salad and Selenium egg are not reported in failure cost.

Fig 1. (a) Vegetable salad production line of The Royal Project Foundation; (b) Selenium egg packhouse

3.3. *GMP and HACCP annual quality cost model*

Table 2. GMP and HACCP quality cost model in Thai Baht excluded facility construction cost

Cost categories	GMP		HACCP	
	Salad packhouse*	Selenium egg packhouse	Salad packhouse	Selenium egg packhouse
Prevention cost (PC_i)	***140,800 (76.3%)***	***68,480 (58.8%)***	***69,500 (46.4%)***	***124,000 (70.7%)***
PC_1: design, implement assurance plan	50,000	33,480	28,000	89,000
PC_2: planning program	25,000	5,000	11,500	5,000
PC_3: sanitation	55,800	10,000	0	0
PC_4: preventive maintenance	10,000	20,000	30,000	30,000
Appraisal cost (AC_i)	***43,700 (23.7%)***	***47,980 (41.2%)***	***80,200 (53.6%)***	***51,300 (29.3%)***
AC_1: control for raw material	36,000	13,480	0	0
AC_2: sampling and analysis	5,900	14,500	14,800	48,600
AC_3: in-process control	1,800	20,000	65,400	2,700
Internal failure cost (IF_i)	***0***	***0***	***0***	***0***
IF_1: reprocessing	0	0	0	0
IF_2: low labor productivity	0	0	0	0
External failure cost (EF_i)	***0***	***0***	***0***	***0***
EF_1 : claims, recalled products	0	0	0	0
Total	**184,500 (100%)**	**116,460 (100%)**	**149,700 (100%)**	**175,300 (100%)**

* Facility construction cost in order to implement GMP 1,832,000฿

Table 2 summarized for the total quality cost of GMP and HACCP first year implementation of both salad pack and Selenium egg packhouse. The distributions of each types of cost between these two products are different because of the characteristic risk of products.

4. Discussion

The total qualify cost model shown high promising to apply for fresh produce manufacturers according to both preliminary case studies. The cost information can be recorded annually and analyzed to see the improvement. With this kind of tool, the manufacturer can decide the proper level of quality management activity in order to see the value added to their business operation. Salad is relatively higher risk for food safety. The manufacture has invested for high proportion in prevention cost in a pre-requisite program, GMP in order to manage the food safety. Consequently implementing HACCP, salad packhouse invested in high proportion for appraisal cost to prove for the effectiveness. For egg packhouse, the product characteristic is a raw material the company lower invested in GMP program but had invested higher proportion in HACCP prevention cost in order to upgrade the standard of the processing. Both of cases currently haven't found the defective situation therefore no failure cost is reported.

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