Motivation For and Cost of HACCP in Indian Food Processing Industry

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ABSTRACT

To remain quality competitive in the post-WTO regime, Indian food processing firms would have to adopt a food safety management system - Hazard Analysis and Critical Control Points (HACCP). It is necessary to understand, therefore, in what way the system benefits firms, and, what are the costs of HACCP implementation. This paper does that. Data on reasons for and cost of HACCP implementation was generated through questionnaire survey of food processing firms. Analysis was performed using factor analysis, contingency tables and chi-square tests. While quality and production related factors motivate firms to employ HACCP, trade associations are not at all instrumental in promoting the system. Set-up cost and operating cost vary with the type of food sub-sector and the size of firm. Government and trade associations may facilitate sector specific concessional loans for HACCP implementation and initiate training programmes. Economies of scale are important in HACCP adoption, hence Indian firms may want to go for horizontal and/or vertical integration.

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1. Introduction

In the early 1960s, National Aeronautical and Space Application Center (NASA), interested in developing zero-risk food for the astronauts, requested Pillsbury Corporation to come up with a safety management system for food production, now popularly known as Hazard Analysis and Critical Control Points (HACCP). Soon Pillsbury Corporation saw potential for commercial use of HACCP and implemented it in its own food processing plants. In 1993, realising the benefits of HACCP for commercial application, Codex Alimentarius Commission (CAC), a global organization involved in harmonization of food standards, recommended adoption of HACCP in food processing plants (CAC 1996). Moreover, the agreement on sanitary and phytosanitary measures reached under the auspices of World Trade Organization (WTO) endorsed the recommendation of CAC (WTO, 1995). Taking the cue from CAC and WTO, United States (US) and European Union (EU) also incorporated HACCP implementation in their domestic food laws.

In the post-WTO regime, there were instances where foreign buyers refused to accept Indian processed food products, for Indian firms did not adopt HACCP system. As a result exporting firms were paying hefty sums to foreign consultants for HACCP implementation (CM, 1997). Although some exporting firms did employ HACCP, they formed a small part of the Indian food processing industry. With the exception of some, import competing domestic firms have not paid serious attention to HACCP implementation. In fact, there is a lack of information regarding the usefulness of the system and the estimated implementation expenses for the various sub sectors of the food industry. Central government has announced a subsidy scheme for HACCP

implementation without knowing the sub-sector specific expense requirements for HACCP implementation.

Apart from the detailed and meticulous product specific HACCP plans drawn by food technologists, no study in the past has looked at HACCP implementation issues in the Indian context. In this context, the paper provides a theoretical background to HACCP as a safety and quality management system, and analyses issues relating to the HACCP implementation at firm level with emphasis on motivating factors as also the cost implications. Sector specific set-up cost and operating cost are identified and estimated through questionnaire survey of food processing firms. The study draws important policy implications, which do not get identified and understood when viewed from a macro perspective of policy makers. The policy implications are important for promoting HACCP adoption in the food industry.

2. Quality Management and HACCP

Management of quality has evolved over time. The initial phase was characterised by 'Inspection' of the final product. If we go way back in time, there was 100 percent inspection. Viz. each cannon ball produced had to be inspected by putting it in a cannon to see if it loads properly or not. Later, of course, as production techniques advanced, sample inspections of the end products began to take place. The second phase in quality management was called, 'Statistical Quality Control.' Here statistical tools such as control charts were used to ascertain whether or not certain parameters of a given product were within a specified tolerable range (Shewhart, 1931). The control charts could be applied during the production process, and,

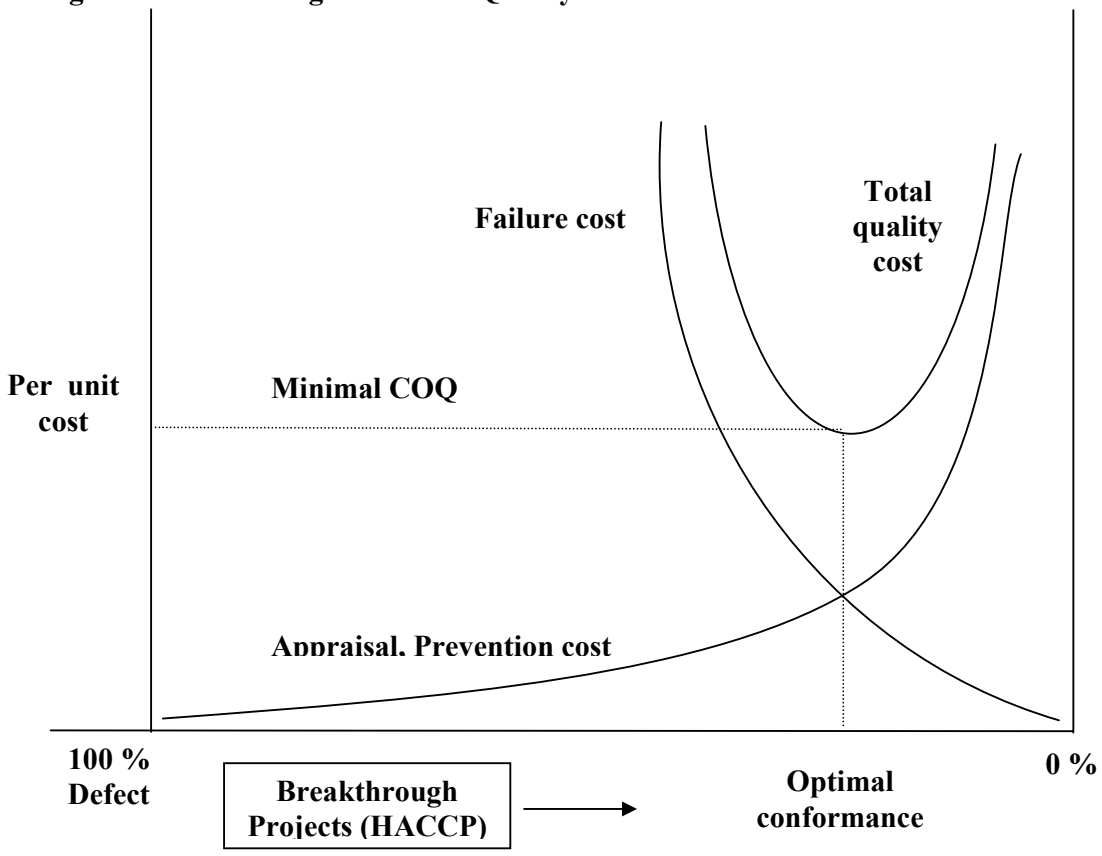
therefore, control could now be moved from end product testing to prevention of failure in the production process itself.

From 1950s onwards, concepts such as 'cost of quality', 'total quality control', and 'zero defects' emerged which were grouped into a common terminology called 'Quality Assurance.' This was the third phase in quality management. Juran (1951) observed that cost of quality could be divided into avoidable and unavoidable costs. The normal costs of inspection and process control (prevention cost) were unavoidable, for production performance had to be monitored. However, costs of product failure were now termed as avoidable. These would include cost of scrapped material and its disposal, cost of labour hours for rework, complaint processing, and financial losses resulting from unhappy customers. Such costs could be drastically reduced by investing in quality improvement. Therefore, in Quality Assurance, one would look at quality management as a system right from input procurement to selling the final product, and, required lot of documentation and involvement of everyone in the organization. HACCP, considered as a quality assurance system would reduce the avoidable costs. As depicted in Figure 1, breakthrough projects such as HACCP could be projected to lower the total cost of quality.

The last phase in quality management was the 'Strategic Quality Management.' It was built on the earlier concepts of inspection, quality control and quality assurance, and was much more comprehensive in its perspective. It emphasised commitment to quality by top management, development of human resources and retraining of workers through role modelling, and defining quality dimensions from consumers' perspective and translating them into controllable manufacturing-based quality attributes. For this purpose, market research on quality and continuous improvement became important parts of strategic quality

management. The focus of this paper has been on the food quality assurance system, HACCP.

Figure 1: Minimizing the Cost of Quality



HACCP is a food safety management system based on logical, scientific approach to controlling safety problems in food processing in a timely manner. By using HACCP, control is transferred from end product testing (i.e. testing for failure) to the design and manufacturing of foods (i.e. preventing failures). HACCP is product specific and plant specific, and therefore, a unique plan has to be chalked out for each product and/or process. In Principle, HACCP can be applied throughout the food chain, starting from the primary producer to final consumer. HACCP comprises of three aspects: Good Manufacturing Practices (GMPs), Preliminary Steps, and The Seven Principles. The first is a prerequisite for implementation of HACCP. Before

HACCP is implemented it is a prerequisite that the food manufacturing plant follows GMPs. For example, hygienically clean shop floors and premises are extremely essential for food production. The Preliminary Steps involve forming a HACCP team which would include representatives right from the top management to the shop floor worker, chalking out flow chart of production process and related activities. The Seven Principles of HACCP are as follows: 1. Conduct hazard analysis, 2. Identify critical control points (CCP), 3. Set critical limits for each CCP, 4. Establish monitoring procedure, 5. Establish corrective action, 6. Establish record keeping procedure, and 7. Varification and validation of the system. The details of each of these aspects are available in Deodhar and Dave (2001).

3. Data and Methodology

Implementation of HACCP in Indian firms has been on the rise, especially since the signing of the WTO agreement on sanitary and phytosanitary measures. Firms have been spending large amounts on HACCP implementation. Hence, through a questionnaire mail survey, I sought responses on various issues associated with HACCP. The questions tried to elicit motivation factors and the cost considerations in implementing HACCP in food processing firms. Questionnaires were sent to more than 500 food companies and response was received from 50. Given that the response to mail surveys has always been low, an absolute response of 50 is a good number. Nganje, Mazzocco, and McKeith (1995) observed that HACCP implementation issues depended on size and nature of food sub-sector. Among the 50 respondents, we did have a fair representation of various sub-sectors of the food processing industry. There was also a good representation of firms that were small scale units and non small-scale units, and those that were export oriented units or

otherwise. The information regarding the 50 firms in terms of their size, nature of food sub-sector, and HACCP status is presented in Tables 1 and 2 below.

Table 1: Classification of Respondent Firms

No.	Type of Company	No. of Respondents				
		SSI*	Non-SSI	EOU	Domestic	Total
1	Fruit and Vegetable Processing	5	4	4	5	9
2	Seafood Industry	8	7	14	1	15
3	Dairy Products	1	19	4	16	20
4	Spices	3	1	1	3	4
5	Others	0	2	1	1	2
6	Total	17	33	25	25	50

* Companies with investments of Rs. 1 crore or less.

Table 2: HACCP Status of the Respondent Firms (No. of respondents)

No.	Type of Company	HACCP in place	Under Development	Plan to Implement	No plans to Implement
1.	F & V Processing	2 (1*)	2	4	1
2.	Seafood	10 (2*)	4	1	0
3.	Dairy Products	9	2	4	5
4.	Spices	1	0	1	2
5.	Others	0	0	2	0
6.	Total	22 (3*)	8	12	8

* HACCP certification awaited

The respondent firms included 17 firms in the small-scale industry (SSI) category and 25 firms were export-oriented units (EOUs). While most of the seafood firms were EOUs, units making dairy products served mainly the domestic market. Except one, all the dairy firms were non-SSI units. On the other hand, the 15 seafood firms and 9 fruits and vegetable processing firms were almost equally divided into SSI and non-SSI units. Among the firms studied, investment in plant and machinery varied from a minimum of Rs. 1 lakh to a maximum of Rs. 70 crores.

Of the 50 firms, 22 had already implemented HACCP and 8 were in the process of implementation. 12 had plans to implement HACCP and the remaining 8 did not want to implement it. Not surprisingly, all these remaining 8 firms were serving only the domestic market. No seafood firm unit was averse to implementing HACCP, and, in fact most of these units had adopted HACCP. Thus, it was clear from these numbers that units averse to adopt HACCP were serving the domestic market. The data gathered on the 50 firms was used to ascertain which factors motivated the firms to implement HACCP, what were the set-up and operating costs involved in HACCP and whether or not there were economies of scale in implementing HACCP. Statistical tools such as factor analysis, chi-square tests were used to analyse the data.

4. Motivating Factors for HACCP Implementation

What were the reasons for which firms were ready to adopt HACCP? To get as broad a perspective as possible, I asked respondents to score the importance of 12 various reasons for the HACCP adoption on a scale of 0 to 9 with 9 being extremely important. Results of the average responses for various sub-sectors of the food industry are described in Table 3 below.

Across all sub-sectors of the food companies, 'Improve Product Quality' received the highest score exceeding 8.5. 'Consignment Rejection/Detention' was rated very high (8) by the spices units, but was of no concern to dairy sector. This probably reflects the fact that most of the dairy units are selling goods domestically where strict inspection rules are not laid down by domestic buyers. Moreover, 'Recommended by Trade Organisation' was rated the lowest (3.94) among all food categories and among all reasons in the case of dairy sector. This could be an

indication that trade organizations were either not very active, or they had yet to realise the importance of HACCP.

Table 3: Sector-wise Average Scores for HACCP Adoption Reasons (scale 0 to 9)

No.	Reasons	F & V Processing		Seafood		Dairy		Spices	
		Mean Score	Std Dev	Mean Score	Std Dev	Mean Score	Std Dev	Mean Score	Std Dev
I	Meet the need of major customer	6.71	2.87	7.73	1.79	7.41	2.15	7.00	2.83
II	Generally regarded as good practice	8.14	1.46	8.00	1.25	8.24	1.03	8.00	1.41
III	Improve control of production process	7.75	1.58	8.07	1.53	8.24	1.15	8.50	0.71
IV	Improve product quality	8.57	0.79	8.53	0.74	8.76	0.44	9.00	0.00
V	Attract new customers	6.75	3.24	6.60	2.38	6.65	1.58	7.50	2.12
VI	Hold on to existing customers	7.29	1.89	7.00	2.04	6.76	2.41	8.50	0.71
VII	Reduce customer complaints	7.29	1.80	6.13	3.16	7.88	1.41	7.50	2.12
VIII	Improve efficiency/ profitability of the plant	6.86	2.61	7.07	2.09	7.06	1.64	6.50	0.71
IX	Reduce product wastage	6.14	2.12	6.13	3.16	7.76	1.52	5.00	0.00
X	Recommended by trade organizations	6.71	2.63	5.67	3.11	3.94	3.07	6.50	2.12
XI	Access new overseas market	7.75	1.58	6.67	2.32	5.31	3.42	7.50	0.71
XII	Consignment rejection/ detention	6.29	3.20	4.53	3.11	4.94	3.56	8.00	1.41

As described in Table 3, I used 12 variables to elicit reasons for HACCP adoption, to get as broad a perspective as possible from the food companies. Having received answers to these 12 reasons, it was important to understand whether there

were some basic factors underlying these 12 reasons. If one could reduce these 12 variables to a manageable set of 3 to 4 factors, one can use the information more productively. Factor Analysis is a technique which is employed for this purpose to summarise a large number of similar variables into a group of a few underlying factors. I used factor analysis technique to identify the underlying factors driving the 12 reasons for adoption of HACCP (see Appendix I for details).

The factor analysis provided with 3 factors under which 11 of the 12 variables were grouped into. To understand the relative importance of the 3 factors, we calculated mean scores for each of these 3 factors by taking arithmetic average of the variables grouped under the respective factors. We named the factors and grouped the variables as presented below in Table 4. The table shows the relative importance of the 3 factors for the sub-sectors of the food industry on a scale of 0 to 9. From Table 4 it appears that Production Related Reasons are important for adoption of HACCP across all sub-sectors of the food industry. The 'Other Factor' which includes consignment rejection and recommendation by trade organizations is least important factor among the 3 factors. It may be that trade associations are not active enough to sensitise companies about HACCP. Companies in the spices sector seem to give equal and significant importance to all the motivation factors.

Table 4: Mean Score of the Underlying Factors (scale 0 to 9).

No.	Factors	F &V	Seafood	Dairy	Spices
1.	***Production Related Factor***	7.46	7.32	7.99	7.42
II.	Generally regarded as good practice				
III.	Improve production process control				
IV.	Improve product quality				
VII.	Reduce customer complaints				
VIII.	Improve efficiency/ profitability of the plant				
IX.	Reduce product wastage				
2.	***Customer Related Factor***	6.92	7.11	6.94	7.67
I.	Meet the need of major customer				

V.	Attract new customers				
VI.	Hold on to existing customers				
3.	***Other Factor***	6.5	5.1	4.44	7.25
X.	Recommended by trade organizations				
XII.	Consignment rejection/ detention				

5. Cost Considerations in Employing HACCP

HACCP implementation being a relatively new concept and the costs associated with it being somewhat amorphous in nature, I asked specific questions in the questionnaire to elicit importance of various cost items, and the rupee amounts of two types of cost, namely, set-up cost and operating cost.

Set-up Cost

To understand the importance of set-up cost in HACCP implementation, I listed a number of one-time fixed cost items to be identified as 'major cost' or 'minor cost' by the respondent firms. The analysis of the perceptions of companies is provided in Tables 5 and 6. The important inferences that one could draw from these tables were as follows: More than 60 percent of all firms, and all Fruit and Vegetable Processing firms considered 'External Consultants' cost as a major cost item. This cost was considered as a major cost by more than half of both SSI and non-SSI firms. 75 percent firms considered 'Managerial Changes to Plant' as a minor cost item.

Moreover, 60 percent of all firms considered 'Staff Time in Documenting System' as a minor cost item. However, interestingly, 60 percent of the SSI units considered it as a major cost item. The difference between the responses by SSI and non-SSI units for this cost item was statistically significant. The Chi-square statistic for the test of independence between industry type (SSI or non-SSI) and Major/Minor cost was 5.84 and significant at 0.02 significance level.

I also asked the respondents to provide expenditures on set-up cost. These expenditures, averaged over the firms in each of the food sub-sectors are reported in

Table 7. The cost was highest for seafood sector (Rs. 27.11 lakhs). Dairy sector had the second largest expenditure on set-up cost (Rs. 11.40 lakhs), followed by fruits and vegetable processing sector (Rs. 5.75 lakhs) and the spice sector (2.35 lakhs).

Table 5: Sector-specific Importance of HACCP Set-up Cost (No. of respondents**)**

No.	HACCP Setup Cost Items	F & V		Seafood		Dairy		Spices		Total	
		Set-up Cost									
		I	II	I	II	I	II	I	II	I	II
I	External Consultants	8	0	9	6	8	8	1	1	26	15
II	Investment in New Equipment	3	5	8	7	8	8	1	1	20	21
III	Staff Training	4	4	9	6	8	8	1	1	22	19
IV	Managerial Changes to the Plant	3	4	5	10	2	14	0	2	10	30
V*	Staff Time in Documenting System	4	4	6	9	4	12	1	1	15	26

I = Major Cost, II = Minor Cost.

Table 6: Size-specific Importance of HACCP Set-up Cost (No. of respondents)

No.	HACCP Setup Cost Items	SSI		Non-SSI	
		Set-up Costs			
		Major	Minor	Major	Minor
I	External Consultants	9	4	17	13
II	Investment in New Equipment	7	6	14	16
III	Staff Training	6	7	18	12
IV	Managerial Changes to the Plant	5	8	6	23
V	Staff time in Documenting System	8	5	7	23

Table 7: HACCP Set-up Cost (Rs in lakh)

No.	Type of Company	Set-up Cost
1.	Fruit & Vegetable Processing	5.75
2.	Seafood Industry*	27.11
3.	Dairy Products	11.40
4.	Spices	2.35

* One extreme observation dropped from the calculation

Operating Costs

The other important component of HACCP cost is the annual operating cost. I asked similar questions as in the case of set-up cost, to elicit importance of various categories of HACCP operating cost. The summary of the responses is provided in Tables 8 and 9. 'Record Keeping' and 'Product Testing' were considered to be major cost items by the seafood sector. On the other hand, 'Record Keeping' was overwhelmingly considered to be a minor cost by dairy sector. Similarly 66 percent of seafood and dairy sector firms considered 'Managerial/Supervisory Time' as a minor cost. If one compared the SSI and non-SSI units, it was clear that more importance is given to 'Record Keeping' and 'Product Testing' as major cost items by the SSI sector. In fact, the Chi-square statistic for the test of independence between industry type (SSI or non-SSI) and Major/Minor cost was 5.56 for the item 'record keeping,' and it was significant at 0.02 significance level. Thus, this cost item was very critical to SSI units.

Table 8: Sector-specific Importance of HACCP Operating Cost (No. of respondents)

No.	HACCP Operating Cost Items	F & V		Seafood		Dairy		Spices		Total	
		Operating Costs									
		I	II	I	II	I	II	I	II	I	II
I	Record Keeping	1	7	10	5	1	15	0	2	12	29
II	Product Testing	5	5	11	4	7	9	2	0	25	18
III	Staff Training	6	4	9	6	9	7	0	2	24	19
IV	Managerial/ Supervisory time	5	5	5	10	5	11	2	0	17	26

I = Major Cost, II = Minor Cost

Table 9: Size-specific Importance of HACCP Operating Cost (No. of respondents)

No.	HACCP Operating Cost Items	SSI		Non-SSI	
		Operating Costs			
		Major	Minor	Major	Minor
I	Record Keeping	7	6	6	24

II	Product Testing	11	2	14	16
III	Staff Training	7	6	19	11
IV	Managerial/ Supervisory time	6	7	12	18

The average annual rupee expenditures on operating cost are presented in Table 10. Once again, seafood sector had the highest expenditure on HACCP operating cost (Rs. 6.37 lakhs). The dairy sector came second with an expenditure of Rs. 2.36 lakhs, followed by spices sector (1.27 lakhs) and fruits and vegetable processing sector (0.85 lakhs).

Table 10: Average Annual HACCP Operating Cost (Rs in lakhs)

No.	Type of Company	Operating Cost
1.	Fruit & Vegetable Processing	0.85
2.	Seafood Industry	6.37
3.	Dairy Products	2.36
4.	Spices	1.27

Annualised Total HACCP Cost per Unit of Turnover

One would like to know whether or not the burden of HACCP cost varies with the scale of operation. The best measure of this would have been to compare the annualised total HACCP cost per unit of output. However, different food companies produce different food products, and even the same company produces a variety of food items. Hence, comparison of annualised total HACCP cost per unit of a homogenous food product is impossible. Therefore, I considered annualised total HACCP cost per Rs. 1 crore of turnover for a meaningful comparison across different firm sizes.

The annualised HACCP cost was arrived at by adding the operating cost and the annualised set-up cost. Based on the depreciation charges of plant and machinery

recorded in the annual reports of food processing firms, it was assumed that on an average, plant and machinery needed an overhaul after 10 years. At that time, HACCP set-up costs will have to be incurred again. Hence, $1/10^{th}$ of the set-up cost was taken as a proxy for annualised set-up cost component. Nganje and Mazzocco (1998) also make such an assumption for measuring efficiency of HACCP in US food processing plants. Further, to make comparisons based on scale of operations, I divided the firms into 5 categories on the basis of their turnover - Turnover of less than Rs. 5 crores, turnover between 6 to 10 crores, between 11 to 50 crores, between 51 to 100 crores, and finally turnover greater than 100 crores.

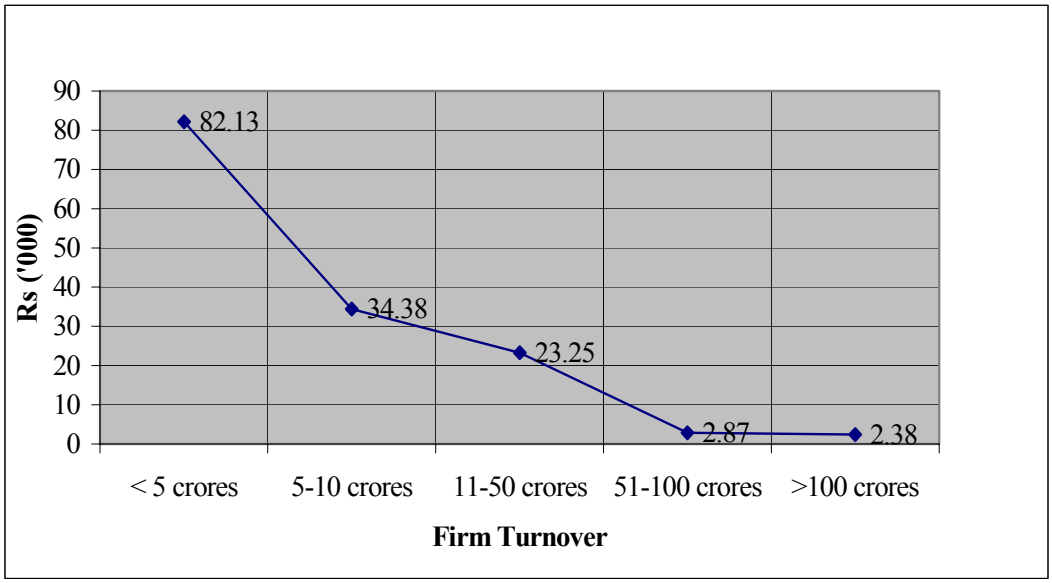
On comparing the HACCP expenses across these categories, it was found that the annualised total HACCP cost per Rs. 1 crore of turnover declined as the turnover increased. As depicted in Figure 2, this expenditure was Rs. 82,130 for firms with turnover of Rs. 5 crore or less. It declined to Rs. 34,380 for companies with turnover between Rs. 6-10 crores. It declined continuously to reach Rs. 2,380 for the firms with a turnover of Rs. 100 crores or more. These estimates indicated that the HACCP cost burden for the smaller firms was much higher than that for the larger firms. This relative cost differential could have a significant impact on small firms who might be operating on a narrow profit margin. Since the overall food industry is made up of a large number of small firms, the HACCP cost could be a major deterrent for implementation of HACCP.

6. Policy Implications

HACCP system is a very effective built-in mechanism for food processing firms to improve the safety and quality of their food products. One also cannot ignore the fact that CAC had recommended it and WTO agreements endorsed its

implementation. Among the HACCP questionnaire respondents, the firms that did not wish to implement HACCP were the domestic companies. This complacency is

Figure 2: Annual Total HACCP Cost per Crore of Turnover



dangerous. In the liberalised trade atmosphere, foreign firms are waiting to enter Indian market and domestic firms would have to improve quality by adopting HACCP. Therefore, time has come that Indian food laws make implementation of HACCP mandatory. But before making HACCP mandatory, one would like to know the potential benefits of HACCP adoption and the associated costs of its implementation. This paper did precisely that.

Among the questionnaire respondent firms, those who had implemented HACCP or were in the process of implementing it, had clearly voted for HACCP by giving highest score to the reason - 'Improve Product Quality.' Factor analysis performed on the variables representing various reasons for adopting HACCP also showed that production related reasons were very important for adopting HACCP. This is a very valuable feedback for the firms that are averse to implementing HACCP

in their plants, and to government that may want to make HACCP mandatory. Non-implementation of HACCP by a significant proportion of firm in the industry could be stemming from 2 reasons. Either the firms are not well informed and aware of its importance, and/or the cost of implementation is prohibitive.

Factor analysis showed that the variables, 'Consignment Rejection/Retention and 'Recommended by Trade Organization' were relatively less important in motivating adoption of HACCP. In fact, trade associations should generally be a good source of information for newer technologies and quality management concepts. They are expected to take-up matters when consignments are rejected or detained. Thus, trade associations, in the interest of the industry, must vigorously suggest and facilitate HACCP adoption in their respective food sub-sectors. HACCP awareness workshops could be conducted by the associations for the firms in their respective food sub-sectors.

Among the various sub-categories of set-up cost, 'External Consultant' cost was considered to be a major cost item by more than 60 percent of the units both in the SSI sector and non-SSI sector. Thus, it appears that although set-up cost varies with the type of food sub-sector, consultant cost is an important component across all the sub-sectors. For SSI units, 'Staff Time in Documenting System,' is a major cost item as compared to the non-SSI units. Thus, SSI units may be offered some amount of financial help specifically for the purposes of documenting HACCP system and for the consulting fees that they have to pay. Seafood and dairy sectors expenditures on HACCP seem to be quite high, and, therefore, concessional loans may be offered to them for HACCP set-up cost expenditures.

Among the various sub-categories of the operating cost, 'Record Keeping' and 'Product Testing' were considered to be major costs by a significant number of SSI

units and the seafood sector. Concessional loans for establishing product testing laboratories in factories, and, offering training programmes for inculcating record keeping habits among workers seem necessary for these companies. Results also show that annualised HACCP cost per Rs. 1 crore of turnover decreased rapidly as turnover increased. Again, the implication is that companies with smaller turnover may be offered concessional loans for adoption of HACCP. Currently, Ministry of Food Processing Industry, Government of India offers a scheme whereby the Ministry provides a grant of 50 percent of the HACCP and TQM related expenses subject to a limit of Rs.10 lakhs. Grants of such kind have potential for misuse and corruption. They be replaced by loans. Second, the grant does not take into account the various sector and size specific requirements. Instead of grants, facilitating specific technical assistance will be very useful. Finally, an important implication is that in a globalised food industry, it helps to grow bigger. Economies of scale operate in becoming quality competitive, and hence, companies will have to seek vertical or horizontal integration.

Appendix I: Details of Factor Analysis

Applicability

Many of the 12 variables capturing different reasons for adoption of HACCP had high correlation among themselves. The high correlations varied between 0.5 to 0.75 and were statistically significant. I further calculated the Bartlett's Test of Sphericity (B) and Kaiser-Meyer-Olkin (KMO) test of Measure of Sampling Adequacy (MSA) to find out applicability of factor analysis to the 12 variables (Hair *et al.*, 1998). I used SPSS package for all the procedures. The results of the two tests are described in Table 1 below. The Bartlett statistics tests the hypothesis that the correlation matrix of chosen variables is an identity matrix. I rejected this hypothesis, as the Chi-square value is very high compared to the critical value. Similarly, the MSA value of the KMO test indicates the proportion of variance in the variables which is common variance, i.e. that might be caused by underlying factors. Values less than 0.50 indicate that factor analysis may not be useful. As Table 1 indicates, the overall MSA value is 0.661. Based on these statistics I concluded that variables are appropriate for factor analysis. I dropped the variable XI, "Access New Overseas Market" for the subsequent analysis, as its individual MSA value was 0.446, which is less than 0.50.

Table A1: Bartlett's and KMO Test

Bartlett's Test	KMO Test
Chi-square = 196.496	MSA value = 0.661
d.f. = 55	
Sig. = .000	

Extraction of Factors

Having decided on the number of variables that I want to use for factor analysis, the next step was to find out the number of factors that underlie the variables. I used the principle component method to extract the factors. The result of principle component analysis is presented in Table 2 below. The method gives out factors equal to the number of variables used in factor analysis. From the set of 11 factors, one has to choose a limited set of factors based on eigenvalues and the percent of variation in the variables explained by the factors. Two rules of thumb are important in choosing the number of factors. First, only those factors be retained, which when sorted in descending order in terms of percent variation explained, cover cumulative 60 percent of the total variation in the original variables. Second, only

those factors be retained which have eigenvalues greater than 1. By both thumb rules, I retained first 3 factors.

Table A2: Factor Extraction Using Eigenvalues and Variance*

Factors	Eigenvalues	% of Variance	Cumulative % of Variance
1	3.939	35.811	35.811
2	1.985	18.042	53.853
3	1.496	13.604	67.457
4	0.990	8.999	76.457
5	0.684	6.220	82.677
6	0.581	5.285	87.962
7	0.472	4.288	92.249
8	0.327	2.973	95.223
9	0.218	1.984	97.207
10	0.198	1.796	99.003
11	0.110	0.997	100.000

* Extraction Method: Principal Component Analysis

Grouping Variables in Chosen Factors

Although I planned to retain 3 factors, I did not know which variables could be grouped under each of these three factors. In fact, once that is done, I would know the characteristic of the underlying factor. Therefore, I calculated rotated component matrix that gave factor loadings for each of the variables. Factor loadings showed correlation between the 3 chosen factors and the variables to be grouped into them. These factor loadings for the variables are presented in Table 3. Large absolute values indicate that a variable and a factor are closely related. On the basis of commonalty among the variables that have large loadings for a particular factor three factors consisting of different variables were identified. These were:

Factor 1: As indicated in Table 3, the following variables were grouped into this factor based on higher values of factor loadings - Generally regarded as good practice (II), Improve control of production process (III), Improve product quality (IV), Reduce customer complaints (VII), Improve efficiency/ profitability of the plant (VIII), and, Reduce product wastage (IX). Almost all of these variables express production related reasons for HACCP adoption. Hence, I called factor 1 as the "Production Related Factor." This factor accounts for 36 percent of the variability in the original set of variables.

Factor 2: Based on the high factor loadings, we grouped the following variables in factor 2 - Meet the need of major customer (I), Attract new customers (V), and, Hold on to existing customers. All the 3 variables are related to holding or expanding the customer base. Hence, I named this factor as "Customer Related Factor. This factor explained 18 percent of the variability of the original set of variables.

Factor 3: Similarly, we grouped the variables - Recommndended by trade organizations (X) and Consignment rejection/ detention (XII) into factor 3. This factor explained 14 percent of the variability of the variables. I called this factor the "Other Factor." The variables in this factor relate to issues of pre-shipment inspection

problems and recommendations by the trade organizations to avoid any non-tariff barriers.

Table A3: Factor Loadings of Rotated Component Matrix*

No	Variables	Factors		
		1	2	3
I	Meet the need of major customer	0.00	0.787	-0.157
II	Generally regarded as good practice	0.806	-0.02	-0.01
III	Improve control of production process	0.800	0.215	-0.338
IV	Improve product quality	0.527	0.234	0.196
V	Attract new customers	0.270	0.772	0.174
VI	Hold on to existing customers	0.147	0.767	0.304
VII	Reduce customer complaints	0.718	0.02	0.345
VIII	Improve efficiency/ profitability of the plant	0.673	0.346	-0.02
IX	Reduce product wastage	0.826	-0.002	0.155
X	Recommended by trade organizations	-0.06	0.422	0.775
XII	Consignment rejection/ detention	0.193	-0.06	0.902

* Rotation Method: Varimax with Kaiser Normalization.

Having selected the 3 factors and grouped the original set of variables into these 3 factors, I calculated the average score of the grouped variables for each of the 3 factors which is reported in the main text.

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