Origin and Evolution of the Modern System of Food Safety Management: HACCP and Prerequisite Programmes

1.1 Historical Perspectives

Food safety management practices have been evolving continually in the food industries of developed nations, particularly since the end of World War II (WWII) in 1945. Nevertheless, despite more than 70 years of progress in the assurance of food safety, failures sometimes occur. The intent of this introduction is to summarise the principal events in the origin and evolution of modern food safety practices so that readers can better understand how to improve practices and to provide even greater food safety assurance in the future.

The beginning of WWII coincided with the end of the Great Depression that had hindered economic progress throughout the entire world during the decade of the 1930s. Western nations mobilised their economic resources during the early 1940s to manufacture the weapons of war. Upon the war's end, the energised economic and manufacturing bases were converted to the building of infrastructure and the production of consumer goods rather than war materials. Several of the principal innovations that impacted food safety were the development and widespread use of mechanical refrigeration and the construction of national transportation systems, such as the interstate highway system in the United States.

Before the widespread use of mechanical refrigeration, many perishable foodstuffs were stored in iceboxes that required frequent replenishment of the ice supply. Iceboxes could not provide uniform or steady cold temperatures. As a result, perishable foods often became unfit for consumption; consumers were forced to shop frequently for perishable goods. Mechanical refrigeration units were able to provide relatively uniform and steady cold temperatures, about 4\(^\circ\) to 7\(^\circ\) C, thereby substantially reducing the amount of food spoilage and potential food safety incidents. The application of mechanical refrigeration was quickly extended to most homes and commercial establishments and to road and rail vehicles for the transportation of refrigerated or frozen foods and food ingredients.

The ability to use refrigerated transportation was greatly facilitated by the construction of modern rail and highway systems. Eventually, the production of refrigerated ocean liners and aeroplanes permitted the shipment of perishable foodstuffs across the oceans. These developments mean that the system of local food production and consumption that was widely used several generations ago has now been largely replaced by a massive global food supply chain in which foods and food ingredients are shipped amongst most nations of the world.
Mechanical refrigeration and lengthened supply chains have enabled the concentration of food production operations into relatively few large facilities that can ship food products to very large geographical areas. This phenomenon has occasionally been responsible for large foodborne illness outbreaks that would have been less likely when food production occurred in multiple smaller facilities, each of which supplied smaller geographical areas. However, it has also given us the opportunity to improve standards in hygiene and safety through specially designed modern food facilities.

A trend towards more convenient foods accompanied these developments. In products such as dried cake mixes, for example, dried eggs and dried milk were added at the point of manufacture so that the consumer would not need to use shell eggs or fresh milk during the preparation of the cake batter. The use of dried ingredients in the place of fresh raw materials was quickly applied to the production of many manufactured foods. This practice brought with it an unanticipated problem – an increase both in the incidence of *Salmonella* contamination and in the number of outbreaks and cases of human salmonellosis.

The reasons for these increases proved to be analogous to the reasons for larger outbreaks of foodborne illnesses being associated with large, centralised food production facilities. In home kitchens, the use of *Salmonella*-contaminated fresh milk or shell eggs in family-sized food portions could, at most, be responsible for a few cases of salmonellosis. However, when *Salmonella*-contaminated dried eggs or dried milk were used in food manufacturing facilities in the production of massive quantities of food, many cases of salmonellosis could result.

The increased levels of pathogen contaminated foods and foodborne illnesses caused great concern in the rapidly evolving and growing global food industry of the 1950s and 1960s. Government regulators and consumers demanded safer foods. These demands were followed by intensified efforts to manage food production in order to reduce the food safety risks. Early efforts to assure food safety attempted to use quality control procedures that had been implemented with the modernisation of the food industry after WWII.

Manufacturers of many types of products, including foods and many household appliances, used similar procedures in their efforts to control quality. These procedures typically included the collection of a predetermined number of samples from a production shift, followed by the testing or analysis of the samples in a laboratory. Statistically based sampling plans were used to determine the acceptability of each production lot. If the number of defective samples exceeded the specification for a particular product, the entire production lot would be rejected. If the number of defective samples did not exceed the specified limit, the production lot would be accepted. The management of quality control was based on product specifications, lot acceptance criteria, and finished product testing.

Despite the applications of contemporary quality control procedures, foodborne illnesses caused by the new food ingredients and products continued to occur. It was discovered that food safety incidents, including foodborne illness outbreaks, were sometimes caused even when the implicated production lot of food was determined to be in compliance with all of its specifications. Repeated incidents revealed a fundamental flaw in quality control procedures that prevented the detection and prevention of such incidents. That fundamental flaw was the inability of quality control procedures to detect defects that occurred at low incidences.
1.2 Origin and Evolution of HACCP

During this same time period of the 1960s, several entities were collaborating on the production of foods for US military personnel and for the manned space programmes. These were The Pillsbury Company, the US Army Laboratories at Natick, MA, and the National Aeronautics and Space Administration (NASA). In an effort to guarantee that astronauts would not become seriously ill during a space mission, NASA had enacted very strict specifications on the foods that it used. All parties soon realised that a food safety guarantee could not be provided without 100% destructive testing of a given lot of food (Ross-Nazzal 2007). Several engineers recognised that the failure modes and effects

Upon extensive investigations of production lots of food that were implicated in foodborne illnesses, it was determined that the foods were typically contaminated with a particular pathogen at a very low incidence. In many cases the defect rate was about 0.1%, i.e. about 1 unit of 1000 analytical units was found to be contaminated. Of course, when many millions of analytical units are produced during a single shift, it is easy to understand how numerous illnesses could be caused by a lot of food that was contaminated at the seemingly trivial rate of 0.1%. Subsequent statistical analyses revealed that 3000 analytical units would need to be tested and found to be negative in order to provide assurance at the 95% confidence limit that a particular lot of food was free of a particular pathogen or similar foodborne hazard (International Commission on Microbiological Specifications for Foods [ICMSF] 2002; Table 1.1). Testing thousands of samples from each production lot of food was obviously impractical.

Additional factors were found to contribute to the inability of product testing to detect food safety defects. These included the uneven, or non-random, distribution of microorganisms in food materials, the variability between different testing procedures, and the competence of the laboratory personnel. In those days, it was not uncommon for plant production personnel to be promoted without training into laboratory positions.

For the reasons described above, reliance on product specifications and finished product testing were clearly inadequate to assure food safety.

### Table 1.1 Probability of rejecting a lot containing a known proportion of defective units.

<table>
<thead>
<tr>
<th>Number of samples tested</th>
<th>Percentage of defective units in lot</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>0.1</td>
</tr>
<tr>
<td>300</td>
<td>0.26</td>
</tr>
<tr>
<td>500</td>
<td>0.39</td>
</tr>
<tr>
<td>1000</td>
<td>0.63</td>
</tr>
<tr>
<td>2000</td>
<td>0.86</td>
</tr>
<tr>
<td>3000</td>
<td>0.95</td>
</tr>
<tr>
<td>5000</td>
<td>0.99</td>
</tr>
</tbody>
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Adapted from International Commission on Microbiological Specifications for Foods (ICMSF) 2002.
Figure 1.1  Space Food Sticks, designed for astronauts and later marketed to the public.

analysis (FMEA) used by the military to test the reliability of electrical components could be adapted to assess hazards and control measures in food production. The early seeds of the hazard analysis and critical control points (HACCP) of food safety were planted. One of the astronaut foods developed at this time, Space Food Sticks, was briefly produced as a consumer product (Figure 1.1). Its development included elements of both the FMEA and HACCP systems. The sticks were designed to be non-crumbling so that they could not contaminate and impair vital instruments in the space capsules. Additionally, they were produced under controlled conditions that provided a high degree of food safety assurance, both for astronauts and, later, for consumers.

Two coincidental events in 1971 hastened the development of HACCP and its use in the food industry. Americans learned of the first event when a national radio broadcaster intoned, ‘Good morning, America, there’s glass in your baby food.’ Farina produced by The Pillsbury Company had been contaminated with shattered glass in its production facility (The New York Times 1971). Pillsbury’s Director of Research, Dr. Howard Bauman, who led Pillsbury’s production of space foods for NASA, decided to apply this new system of food safety management to all of Pillsbury’s consumer food production. In the following month, Dr. Bauman delivered a presentation at the second coincidental event, the 1971 National Conference on Food Protection, sponsored by the American Public Health Association (APHA 1972). His remarks, and those of his fellow panel members, were limited to descriptions of critical control points (CCPs) and good manufacturing practices (GMPs). The term HACCP had not yet entered the professional lexicon, but this was to become one of the key events in the global spread and acceptance of the HACCP system (Table 1.2).
Table 1.2 Events that fostered HACCP development and evolution through the 20th century.

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1923</td>
<td>US Pasteurized Milk Ordinance first published</td>
</tr>
<tr>
<td>1960s</td>
<td>Pillsbury, NASA, and US Army collaborations</td>
</tr>
<tr>
<td>1969</td>
<td>Current good manufacturing practices first published</td>
</tr>
</tbody>
</table>
| 1971 | Pillsbury cereal recall  
National Conference on Food Protection  
Multiple canned foods recalls, *Clostridium botulinum* contamination |
| 1972 | Pillsbury trains US Food and Drug Administration inspectors to apply HACCP to canned foods  
Pillsbury begins application of HACCP to its consumer products |
| 1973 | Canned foods regulations first published |
| 1975 | Pillsbury internal HACCP system complete |
| 1985 | National Research Council recommends HACCP |
| 1988 | National Advisory Committee on Microbiological Criteria for Foods (NACMCF) formed  
ICMSF Book 4, the first entire book on HACCP, published |
| 1992 | NACMCF and Codex adopt seven HACCP principles |
| 1994 | *HACCP: A practical approach* published |
| 1997 | NACMCF and Codex HACCP documents harmonised |

During the early 1970s, the US canning industry experienced a rapid succession of 12 or more incidents of contamination of canned foods by *Clostridium botulinum*. All were accompanied by product recalls and disposals, including one that cost approximately $100 million (Howard 1971). Although few illnesses and one death were associated with these incidents, the US Food and Drug Administration (FDA) recognised that better controls needed to be developed and required for the production of canned foods. Having participated in the 1971 National Conference for Food Protection, the FDA, intrigued by the concept of CCPs, contracted with The Pillsbury Company to conduct a training programme for its personnel responsible for the safety of canned foods. Pillsbury presented a training programme for 10 FDA inspectors in September 1972. Lasting 3 weeks, the programme was almost evenly split between classroom activities and in-plant orientation and inspections at four canning companies. The accompanying instructional materials seem to represent the first substantial use of the term *HACCP* (The Pillsbury Company 1973). The newly-trained inspectors returned to Washington, D.C., and published the canned foods regulations in 1973 (Code of Federal Regulations [CFR] 2002). Based in significant extent upon time and temperature controls, the canned foods regulations bear striking resemblance to the Pasteurized Milk Ordinance (PMO) first published in 1923 (FDA 1997). It seems to the authors that the concepts of food safety based on prevention by adequate controls had long been present, perhaps subconsciously, in the minds of food processors and regulators. It is somewhat daunting to consider that our modern system of food safety management is so young.  
Upon completion of the FDA training programme, Pillsbury began in earnest to apply the HACCP system to the production of its consumer products, a goal that was achieved
in 1975. Increasing awareness of Pillsbury’s new system of food safety management and the obvious effectiveness of the canned food regulations in curtailing further incidents of *C. botulinum* contamination led to a steady adoption of HACCP by other US food processors. A fertile environment for food safety enhancement existed in the United States at this time because of these regulations and because of the 1969 promulgation by the FDA of current GMPs (CFR 1969).

The adoption of HACCP beyond the US food industry received a major impetus by the 1985 publication of a National Research Council report, ‘An evaluation of the role of microbiological criteria for foods and food ingredients (NRC 1985).’ Completely masked by its title, the report included several highly influential recommendations that propelled HACCP forward. The first of these recommended that food regulatory agencies should use proactive procedures to audit food safety compliance by records verification rather than the customary procedures of plant inspections and product testing.

The HACCP system fitted perfectly the description of a ‘proactive procedure’. The report further recommended that the responsible agencies form an ad-hoc Commission on Microbiological Criteria for Foods. Sponsored by four US federal government departments – Agriculture, Health & Human Services, Commerce, and Defence – this commission emerged in 1988 as the National Advisory Committee on Microbiological Criteria for Foods (NACMCF). One of its first charges was to develop a report to guide industry and regulators on the structure and implementation of the HACCP system. At about the same time, the Codex Alimentarius Commission Committee on Food Hygiene (Codex) began working on a similar report and further focussed attention on HACCP came from the International Commission on Microbiological Specifications for Foods (ICMSF), a group established in 1962 whose objectives included, amongst other aims on microbiological criteria, sampling and testing, to assemble, correlate, and evaluate evidence about the microbiological safety and quality of foods (www.icmsf.org). The ICMSF published the first complete book devoted solely to the development and implementation of HACCP in 1988 (ICMSF 1988).

Following an abortive NACMCF HACCP report in 1989, both NACMCF and Codex published definitive HACCP reports in 1992 and 1993 respectively (NACMCF 1992; Codex 1993). Because the United States serves as the permanent chair of the Codex CFH, there was some overlap of personnel between NACMCF and Codex CFH. Accordingly, the two reports were quite similar. They were almost completely harmonised and republished in 1997 (NACMCF 1998; Codex 1997).

As originally developed by Pillsbury in the 1970s, HACCP was based on three principles:

1) Conduct a hazard analysis.
2) Determine critical control points.
3) Establish monitoring procedures.

Several food safety failures with this system after 1972 led to the gradual development and use of additional principles to facilitate better management practices. The 1992 and 1997 reports cited previously describe the seven current HACCP principles:

1) Conduct a hazard analysis.
2) Determine the critical control points.
3) Establish critical limit(s).
4) Establish a system to monitor control of the CCP.
5) Establish the corrective action to be taken when monitoring indicates that a particular CCP is not under control.
6) Establish procedures for verification to confirm that the HACCP system is working effectively.
7) Establish documentation concerning all procedures and records appropriate to these principles and their application.

The global spread of HACCP as the preeminent system of food safety management was greatly facilitated by the Codex report of 1997. Jointly chartered by the Food and Agriculture Organisation and the World Health Organisation of the United Nations, the Codex Alimentarius Commission’s reports have the effect of law between United Nations’ (UN) trading partners who are signatories to the World Trade Organisation. Thus, the humble beginnings of HACCP as a voluntary programme within the US food industry in 1972 evolved into an effective global system. Prominent international publications also facilitated the understanding and acceptance of the HACCP system of food safety (ICMSF 1988; Mortimore and Wallace 1994, 1998, 2013). There is now a global understanding and implementation of a food safety management system that is the same in almost every country. This is a remarkable achievement that can serve as a model for international cooperation and improvement in additional areas such as animal, plant, human, and environmental health – areas that interface with our efforts to assure food safety.

Despite this promising history, HACCP has sometimes been misused as it was incorporated into regulations. Three prominent examples illustrate this unfortunate situation in the United States (Sperber 2005a).

The first of these was a final rule published by the US Department of Agriculture (USDA): Pathogen reduction; Hazard analysis and critical control point (HACCP) systems (CFR 1996). Commonly known as the ‘megareg’, this very lengthy document required no CCPs to enhance the safety of raw meat and poultry products. Rather, it required conformance to a number of statistical sampling plans that permitted the presence of salmonellae and certain levels of indicator microorganisms. The Salmonella performance standards best exemplify this point (Table 1.3). The performance standards were developed from baseline surveys that were conducted in the early 1990s. In the case of ground beef, for example, the performance standard was determined to be 7.5% Salmonella positives. To monitor compliance with this standard, a single 325-g sample (tested as 5 × 65g subsamples) of ground beef is analysed for the presence of salmonellae each day for 53 consecutive production days. If five or fewer samples are found to be positive for the presence of salmonellae during this period, the production facility is judged to be in compliance with its HACCP plan and no regulatory action is taken. If more than five samples are found to be positive, a second 53-day round of sampling is initiated. If a plant fails three consecutive rounds of such surveillance, regulatory action is considered. One or more years could pass before enforcement action was initiated. Clearly such standards, sampling procedures, and delayed or non-existent enforcement actions are unrelated to HACCP. As most readers already know, HACCP is a real-time food safety management programme in which immediate corrective actions are taken when deviations occur at a CCP. Regrettably, the ‘megareg’ also institutionalised a major misuse of resources, as a great deal of money and labour is necessary to conduct such a programme. While statistically-based sampling plans that
Table 1.3  *Salmonella* performance standards in the US Department of Agriculture ‘megareg’.

<table>
<thead>
<tr>
<th>Species</th>
<th>Performance standarda (%)</th>
<th>nb</th>
<th>c</th>
</tr>
</thead>
<tbody>
<tr>
<td>Broilers</td>
<td>20.0</td>
<td>51</td>
<td>12</td>
</tr>
<tr>
<td>Cows and bulls</td>
<td>2.7</td>
<td>58</td>
<td>2</td>
</tr>
<tr>
<td>Steers and heifers</td>
<td>1.0</td>
<td>82</td>
<td>1</td>
</tr>
<tr>
<td>Market hogs</td>
<td>8.7</td>
<td>55</td>
<td>6</td>
</tr>
<tr>
<td>Ground beef</td>
<td>7.5</td>
<td>53</td>
<td>5</td>
</tr>
<tr>
<td>Ground chicken</td>
<td>44.5</td>
<td>53</td>
<td>26</td>
</tr>
<tr>
<td>Ground turkey</td>
<td>49.9</td>
<td>53</td>
<td>29</td>
</tr>
</tbody>
</table>

aPercentage positive for *Salmonella*  
bNumber of daily samples tested  
cMaximum acceptable number of positives samples  
(Code of Federal Regulations 1996)

monitor the effectiveness of sanitation programmes (which is a better characterisation of the “megareg”) are meritorious, they are more practically conducted with the use of far smaller samples and less expensive analytical methods for indicator microorganisms and tests, such as the aerobic plate count. Moreover, the results of such a sanitation monitoring programme would be closely linked in time to the in-plant cleaning and sanitisation procedures.

Similar criticisms can be made of the FDA HACCP rules for the production of seafood (CFR 1997) and juice (CFR 2001). No CCPs were identified and required for the production of raw molluscan shellfish, the seafood category most identified with human illnesses. Unlike the PMO developed in 1923 for dairy products, no mandatory pasteurisation was required for juice products. Furthermore, exemptions were granted to small producers and retail operations, permitting the replacement of several recommended control measures to enhance juice safety with the weekly testing of a 20 ml sample of juice for the presence of generic *Escherichia coli*.

These three regulations bear no resemblance to the HACCP principles promulgated by NACMCF and Codex. Their promulgation as ‘HACCP’ regulations served to create confusion and undermine the well-deserved and excellent reputation of legitimate HACCP applications.

Despite these several regulatory missteps, numerous effective HACCP rules and regulations have been promulgated by regulators worldwide. Some of these will be highlighted throughout this book. As one example, the USDA (creator of the notorious “megareg”) issued an effective rule to enhance control of *Listeria monocytogenes* in refrigerated ready-to-eat meat and poultry products. This rule recommends science-based alternatives that can be put into place as CCPs, for example, the use of post-lethality surface heat treatments or combinations of food preservatives to inhibit listerial growth (CFR 2003). In addition, the FDA formulated two effective rules: the Pasteurized Milk Ordinance (1923) and the Canned Foods Regulations (1973). Containing multiple CCPs, each of these rules remains effective today.
1.3 The Necessity of Prerequisite Programmes

The global adoption of HACCP did not proceed smoothly without the recognition of the need for additional measures to enhance food safety protection. As a preface to some of our discussion in later chapters, it was learned that HACCP cannot operate successfully in a vacuum. Even with HACCP plans in place, food safety failures sometimes occurred because of inadequate cleaning and sanitation procedures, for example. To be successful, HACCP must be supported by a number of prerequisite programmes (PRPs) (Sperber et al. 1998). We learned that food safety cannot be assured by HACCP alone. Rather, food safety can be much more effectively assured by the combined implementation of HACCP and PRPs (Wallace and Williams 2001). Originally formed to develop and implement HACCP plans, HACCP teams evolved into Food Safety Teams that must consider and manage both HACCP and PRP responsibilities and activities. PRPs are discussed in detail in Chapter 10.

It was also learned that HACCP does not usually work from ‘farm-to-table’, as many had hoped (Sperber 2005b). The types of CCPs that are available in the food processing industry, where HACCP originated, are usually not available at the ‘farm’ and ‘table’ ends of the farm-to-table spectrum. Rather than thinking about farm-to-table HACCP, we should be thinking about farm-to-table food safety. A hazard analysis can be conducted at every step of the farm-to-table supply chain. When no CCPs are available to control a significant hazard at the ‘farm’ end (e.g., pathogen colonisation of live animals), PRPs could be put into place to reduce the pathogen burden in the following links of the chain.

1.4 Recent Regulatory Developments in the United States

It has been obvious for more than four decades that, when it has been properly implemented, HACCP works well to assure the safety of processed foods, such as meat, dairy, and vegetable products where CCPs such as freezing, retorting, or cooking are easily applied and controlled. This success, however, contributed to false expectations on the part of many consumers and others unfamiliar with the food industry that all foods could be produced and marketed without being contaminated with pathogenic microbes. For the many foods that are consumed raw or undercooked, such as produce and raw meats, it is both unrealistic and unscientific to assume that these can be free of pathogens when no CCPs are available (Sperber 2005b). Simultaneously, consumers and their advocacy groups unwittingly blocked the use of treatments, such as electronic-beam radiation, that would improve the safety profile of such products with unscientific claims such as ‘irradiated poop is still poop’.

Beginning about a decade ago, the FDA undertook a major effort to improve food safety outcomes by developing the Food Safety Modernization Act (FSMA) to be applied to some of the foods it regulates. This may have been a reaction stimulated by several major incidents during 2006–2008 (historically the game-changing improvements to food safety and regulation have been driven by failure [Acheson 2014]), but it was long overdue. The FDA likely was reacting to an outbreak of *E. coli* O157:H7 in fresh spinach, the deliberate contamination of imported wheat gluten with melamine, and the widespread cover-up of *Salmonella* in peanut paste, which was used in hundreds of food products.
Today, there are a few who think that FSMA will be not only unproductive, but might also impose extreme and counterproductive measures on the facilities it regulates. There are many others however, who are keen advocates and supporters of the FSMA and in particular, the preventive approach, as it so well marries HACCP and PRPs. One of the reasons for food safety failure (despite having a HACCP plan) is the disconnect between the two when undertaking a hazard analysis and establishing control measures. The gap has demonstrated lack of real understanding in many company HACCP plans and food safety programmes. Some operators are optimistic that the FSMA approach will help bridge that gap.

A review of the FSMA content shows that it is based largely on what has been covered very effectively by the food industry’s HACCP plans and PRPs for the past 40 years; however, the benefit of having FSMA has been to bring these best practices very much to the fore and to require them for all the many food industries in the United States who, surprisingly, were not using the approach because it was not mandated. There are a number of regulations (rules) that have been published under the FSMA. We will not have the space to go through the US and other countries’ food safety regulations in detail here, and there are many other sources of that information (FDA 2011b; Neale et al. 2016). What is relevant to note, however, is that two of the rules under FSMA, the Preventive Controls rules for Human and Animal Feed (2015), have the goal of identifying hazards (known or reasonably foreseeable), which may exist other than at CCPs and require a preventive control. Experienced supporters of HACCP know that in some company HACCP programmes there has long been provision for preventive control points (PCPs) or control points (CPs); (Mortimore and Wallace 2013), but that was voluntary and the company’s own choice to do (i.e. not standardised). The FSMA makes it an approach that any manufacturer or importer into the United States is required to take.

Despite its lengthy time and cost of development, FSMA unfortunately has a relatively small involvement in the US food supply. While the FDA regulates about 80% of the US food supply, these foods account for a very low percentage of foodborne illnesses. Spread by food handlers in foodservice and institutional operations, norovirus is responsible for 58% of all foodborne illnesses in the United States. However, the FDA does not regulate food preparation and handling in these operations. The FDA also does not regulate meat and poultry products. These are regulated by the USDA, which account for 22% of the US food supply. The United States, perhaps along with other countries in the same food-regulatory quandary, could benefit from the formation of a single federal food safety agency that would bring a unified and scientific approach.

1.5 The Future of HACCP

The evolution of HACCP principles in developed countries from 1972 to 1997, a period of 25 years, seems quite rapid in the flow of global political events. However, we are optimistic that the continued globalisation of HACCP throughout the developing countries will proceed much more quickly. A major reason for the more rapid implementation of HACCP in developing countries is the quickly increasing globalisation of food trade. Global trading partners benefit by the uniform application of the most effective food safety procedures. In particular, aided by the inherent authority of the
Codex HACCP document, global food corporations have been largely responsible for the globalisation of HACCP.

The HACCP system was expanded from three principles in 1972 to seven principles in 1992. Whilst it may be reasonable to anticipate that additional principles will be developed and added in the future – as will be discussed in Chapter 4 – at the time of writing, it seems unlikely. The Codex Alimentarius Committee (CAC) agreed to open up the principles of food hygiene and HACCP for revision in 2015. The seven principles are so well incorporated into global regulations and private standards that it seems likely to remain at the same seven at this stage. However, there will be changes aimed at clarifying a number of the more difficult areas, including hazard analysis. It will take time for all stakeholders to agree on what the changes are.

Looking into the future, it is quite likely and appropriate that the HACCP system will continue to evolve. There is already an emerging recognition that even the broad matter of food safety cannot be managed in isolation from other health systems. Rather, food safety systems of the future will likely interface more directly with animal, human, and environmental health, and food security programmes. At the end of the 20th century, HACCP systems were positioned as the ‘crown jewels’ of a food safety programme, supported by PRPs. This particular arrangement should persist for a very long time, but it will likely become integrated into a much larger network that includes public health, animal health, food security, and agricultural sustainability.

1.6 Conclusions

The reader should remain aware that almost all of the progress in the development of HACCP as an effective food safety management programme and its global acceptance and use has been accomplished by the voluntary efforts of global food companies, beginning with The Pillsbury Company in the 1970s and continuing today with the efforts of many dozens of responsible and progressive food companies. Except for the 1997 Codex document that gave guidance for the use of HACCP and hygienic practices, and ongoing participation in Codex committees, there has been very little contribution to this effort by federal and intergovernmental public health and food agencies until recently. We will propose bold recommendations for the future effective involvement of federal and intergovernmental organisations in food safety matters in Chapter 4. Such involvement will be essential in order to maintain food safety in the rapidly changing global food supply chain.