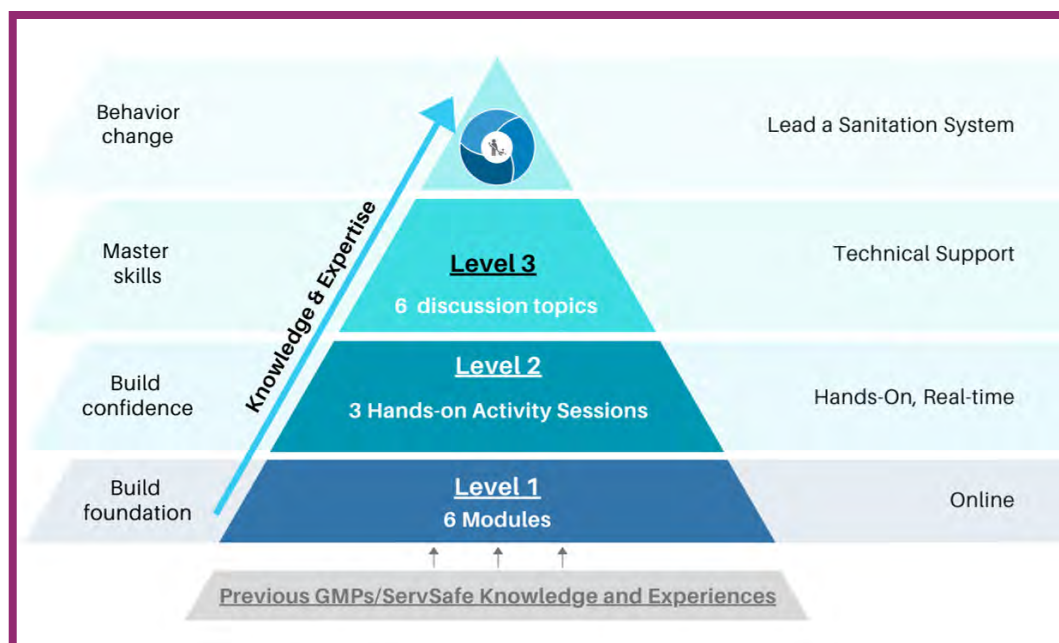




Identification of Sanitation Job Tasks for Food Manufacturers Using a Modified Delphi Approach

ABSTRACT

Identifying core job tasks for sanitation-related roles in the food industry is critical to ensure that sanitation nonconformances in the field are mitigated and that companies maintain a well-qualified food sanitation workforce. Due to the rise in food safety sanitation concerns and undertrained staff, it is imperative to have a streamlined approach to recruitment, including a list of common expectations and training programs for newly hired workers and all employees performing sanitation-related practices. This study aimed to identify and refine job tasks that sanitation operators, managers, and business owners can expect to perform in a food production space using the modified Delphi method and inform a hybrid sanitation training program (online modules and in-person, hands-on activities) for small food processors. The Delphi method allowed for the inclusion of professionals representing various sectors of food safety who provided valuable perspectives based on their experiences in the field. Ten experts representing food safety professionals in academia, sanitation chemical companies, and industry

were given two rounds of questionnaires that specified initial sanitation job tasks and subsequent competencies for three tiers of sanitation roles. The prospective job roles and job responsibilities that were to be addressed in a series of online modules were included in the questionnaire and ranked using a 5-point Likert scale of varying levels from “strongly agree” (5) that our list included the correct job tasks for a respective role within a food safety system (operators/temporary hires, managers (quality managers, sanitarian, and plant managers), and CEOs or business owners), to “strongly disagree” (1) that our list included the correct job tasks for a respective role within a food safety system. Participants were then allowed to add new job tasks to our list if they felt any were omitted. Round 2 of the Delphi was prefaced with an updated draft of the JTA for each role, which was revised to include a more finite list of job roles and competencies based on survey results and add-on job tasks from round 1. Participants were asked to follow the same procedure again in round 2. Consensus (acceptance criterion) was based on a 75% agreement ranking, with a rating of “4” or greater.

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The prospective job roles and responsibilities to be addressed in the in-person modules of our program were ranked differently than the online module content. The Delphi survey asked participants to use a ranking system (rank the 8 in-person topics on a scale from 1–8 in the first Delphi round), how important it was to include specific topics in our final programming. Rankings ranged from “extremely important to include this topic in our final in-person hands-on programming” (which would place the respective topic in 1st place out of 8) to “not important at all that the topic be included in our final in-person hands-on program.” Following the initial ranking questions, respondents were also asked to provide justifications and/or additions to the list. After the 1st round of questionnaires, revisions were made to the original document based on consensus and open-ended text responses. Since a small population took the survey, and for programming length considerations, round 2 narrowed down the final list of hands-on topics from 8 to 6. The subsequent questionnaire (round 2) reflected these revisions, and the “final” format was presented to the panelists after analysis. This study presents the JTA framework as both a guideline for setting expectations of a food sanitation team within a production environment and a resource for training providers developing advanced sanitation curricula. This work identifies a Job Task list which can be used by food safety educators or processors responsible for training to develop competency and skill-based training metrics for sanitation

INTRODUCTION

The lack of sanitation has been cited as one of the top reasons for food safety violations in food production settings in recent years (33). Sanitation concerns range from improper use of cleaning or sanitizing tools to shortcomings in the implementation of current good manufacturing practices among employees (31). Sanitation, as defined in this work, are cleaning and sanitization activities and general sanitary competent food safety professionals has become a significant concern, as sanitation nonconformance dominates inspector reports (34). The food industry is notorious for high turnover rates of employees; small facilities are especially impacted by compliance concerns and low resources to maintain a sufficiently trained staff (7). The Food Safety Modernization Act (FSMA) underscores the need for increased sanitation training of food safety officials, and the United States Department of Agriculture (USDA) is coping with an insufficient number of trained professionals in food safety sanitation (9). Due to the rise in food safety sanitation concerns and undertrained staff, it is imperative to have a streamlined approach to recruitment, including a succinct list of common expectations and training programs for newly hired workers and all employees performing sanitation-related practices.

Sanitation expectations in food and non-food-related sectors have risen since the start of the COVID-19 pandemic, thus creating a large influx of sanitation job roles in open-access online job sites (5). This strong need for sanitarians has, in turn, created a need for more targeted training to efficiently and effectively onboard new workers (16). Developing a refined document an initial overview of current roles in sanitation spaces will help aid in effective training standards within food sanitation.

A Job Analysis (JA) is typically used to determine a job's roles in a particular industry or discipline (30). A Task Analysis (TA) is a process used to determine how to perform common job roles (11). Therefore, a Job Task Analysis (JTA) can be used to determine specific roles in a particular job sector (15). JTAs have become increasingly popular in guiding the development of a training curriculum intended to prepare individuals for job competency through defined learning experiences based on expert feedback, skills, and attitudes that align with the current needs of the industry (13). Competency and skill-based training have not yet been widely adopted in the food industry. Still, organizations such as the International Food Protection Training Institute (IFPTI) are leading the charge in making this training style a standard (10).

Refining competency tasks to be included in training materials is often a subjective process in which professionals in the field base the content on what they consider important to include within a course. Examples of such techniques include the Delphi technique (4), and the Developing a Curriculum (DACUM) method (14); both of different forms of commonly used iterative survey approaches. The RAND Corporation originally developed the Delphi method for insight mining and consumer and stockholder perceptions, but it has been adapted to aid in the specific goals of this study (12). The Delphi technique is a structured communication process used to survey and collect expert opinions on a given topic. Other successful food safety and defense programs have used the Delphi approach to address key training gaps in the food industry (18). The DACUM Method is a structured verbal communication-based survey approach used to collect expert responses on a topic. While the DACUM has been used in policy development and program planning, it has proven impractical in past published work (18). The Delphi Method was chosen over other techniques, such as the DACUM method, because it employs an expert panel to identify needed competencies in a particular topic. Therefore, a modified Delphi approach was used in this study to identify sanitation-related job role competencies to aid in sanitation training requirement. This modified version of the traditional Delphi technique is similar in structure to the conventional Delphi, involving several iterations of surveys to experts to reach a consensus, similar to that used by Quynh et. al. (26). An outline of the Delphi approach used in this work can be found in *Figure 1*.

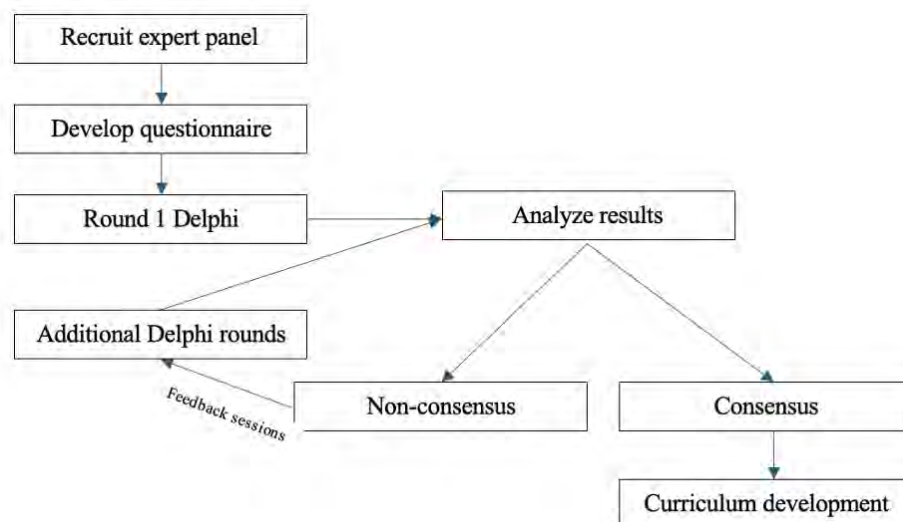


Figure 1. The process used in obtaining expert feedback on sanitation-related food safety job tasks to inform online and in-person, hands-on program modules using a modified Delphi approach.

Based on the current need for a refined list of sanitation-related job role expectations and the need to inform hands-on sanitation training methods, academics from the University of Massachusetts Amherst, North Carolina State University, and the University of Maine aimed to create a streamlined list of 33 job tasks and sanitation-role expectations that aligned with the current needs of the industry and regulating bodies. The purpose of this work was to identify the most common competencies (knowledge, skills, and abilities) needed to successfully perform a sanitation job/role through a tiered ranking of importance from experts within the food safety sanitation profession, stakeholders in the food industry, and regulators using a modified Delphi survey process.

This work aims to identify an exhaustive Job Task List for multiple common sanitation roles seen in the food industry, which can be used by food safety educators or processors responsible for training to develop competency and skill-based training metrics for sanitation employees. The final JT list derived from the Modified Delphi approach used in this work was inform the module content for the Sanitation Controls Practitioner Program (SCPP). The job tasks in the final list were separated into two categories: virtual module content (online programming) and in-person hands-on content (in-person programming), thus comprising our final hybrid SCPP. Both of these subgroups (online and hands-on) were ranked on a Likert Scale in different sections in the Delphi surveys conducted.

MATERIALS AND METHODS

Modified Delphi Method

A modified Delphi Method was used to identify subsequent job responsibilities that food processors might

encounter when hiring in their facility and thus build out appropriate training that covers all major roles and responsibilities. This process aims to gather expert feedback to inform critical decision-making and curriculum development in subsequent work. This method included two cycles of expert input throughout the defining process of the JTA.

Experts and Self-Identifying Experts can be defined as people who have a good understanding of a specific topic (in this case, food safety sanitation) but varying experiences with that topic (they have varying accurate knowledge of a topic and can provide differing perspectives) (17).

Initial list of job roles and job task framework development

A collaborative group of eight academics from UMass Amherst, North Carolina State, and UMaine conducted the modified Delphi process. The team first performed an intensive online search to develop an initial list of food sanitation job roles and subsequent competencies. The initial list of job roles and competencies is based on (1) current job postings in the field, (2) a review of the literature regarding sanitation shortcomings in the food industry, and (3) regulatory insight from past inspection reports in the field. Job Task Competencies were defined as skills, knowledge, and abilities that correlate with the success of a sanitation employee in a food safety-related position. Some example job roles used in the identification of the initial job task list for this study are included in Table 1. An outline of our Delphi approach used in this program was derived from past-published work and illustrated Figure 1 above (13). A list of 33 job tasks was developed from this job task analysis.

TABLE 1. Sample job descriptions sourced from online job forums used in part to curate initial job task list

	Role	Qualifications	Job Responsibilities
Sample Job 1:	Production Sanitation	• No prior experience or training • Ability to read and comprehend simple instructions, short correspondence, and memos • Ability to write simple correspondence • Ability to effectively present information in one-on-one and small group situations • Ability to add and subtract two-digit numbers and to multiply and divide with 10s and 100s • Ability to perform these operations using units of American money and weight measurement, volume and distance • Ability to apply common sense understanding to carry out instructions furnished in oral form • Ability to deal with problems involving one concrete variable in standardized situations • Powered Industrial Truck (PIT) Certification	• This person will provide a safe work environment and assist in controlling contamination in the production area • Must be able to keep floors free of contaminants during production • Bag, weigh and store seconds and thirds • Document weights of seconds and thirds for shrink records • Must assist in the general good housekeeping of the area and assist in monitoring and changing hand dip sanitations • Assist in maintaining supplies and chemical sources (for boot scrubbers, and foot foamers) for the area • Expected to adhere to safe work practices, follow GMP and HACCP guidelines, maintain sanitary conditions, and ensure that product safety is maintained. • Report to management any conditions or practices that may adversely affect food safety, food quality or personnel safety • Take out Garbage at end of shift
Sample Job 2:	Sanitation Manager	• 5 years supervisory experience working within the field of sanitation in a manufacturing environment • Understanding of food safety, workplace safety, and food quality standards • Demonstrated ability to direct, coach, and train associates as well as plan, monitor and schedule work • Self-directed and personally motivated with attention to detail • Prior good attendance and performance track record • Ability to read and write English • Must be able to lift 50 lbs • Knowledge of cleaning compounds and safety protocols • Ability to work and adapt to a fast-paced, and dynamic environment • Ability to be flexible and accepting of changing production schedules and direction	• [Location] is seeking a dedicated Sanitation Manager to oversee the execution of daily sanitation and master sanitation requirements • This person will also manage the daily cleaning and sanitizing responsibilities for the facility in accordance with [STATE] health and safety regulations • Recommend improvements in manufacturing methods and sanitation practices to management • In addition to developing and implementing short-term and mid-term business plans for the department, and assists in the development of the strategic plan for the plant and meets all regulatory requirements • Follow all Safety, Food Safety, GMPs and Quality policies and procedures • Coordinates, plans and conducts programs to educate employees about cleanliness, safety and sanitation in the workplace • Inspects facilities and work areas to prescribe corrective actions to reduce the health risks

Continued on the next page.

TABLE 1. Sample job descriptions sourced from online job forums used in part to curate initial job task list (cont.)

	Role	Qualifications	Job Responsibilities
Sample Job 2:	Sanitation Manager		• Assure compliance to all federally & state mandated and local regulations by the production facility to assure food safety for consumers • Follow all Safety, Food Safety, GMPs and Quality policies and procedures • Coordinates, plans and conducts programs to educate employees about cleanliness, safety and sanitation in the workplace • Inspects facilities and work areas to prescribe corrective actions to reduce the health risks • Assure compliance to all federally & state mandated and local regulations by the production facility to assure food safety for consumers • Oversees the storage and use of cleaning chemicals within the plant to prevent unauthorized access or use • Provides advice on methods and procedures to reduce occupational health risks • Determine measures to avoid any recurrence of accidents • Evaluates facilities to ensure compliance with environmental regulations and promotes maintenance of a sanitary working environment • Conducts training in environmental compliance and the handling of hazardous materials • Evaluates facilities to ensure compliance with environmental regulations and promotes maintenance of a sanitary working environment • Conducts training in environmental compliance and the handling of hazardous materials

Expert panel selection

According to Sablatzky (28), the Delphi procedure requires selecting panel members who are knowledgeable in the subject matter being surveyed to yield representative and accurate results. In March and April of 2022, a total of 11 food safety professionals representing the food industry, academia, and sanitation companies were asked to participate in this project through personal email or phone

contact. Participants were offered a small honorarium as compensation for their time and efforts in this study. After disseminating specific information regarding the project, all 11 professionals (4 representing sanitation companies; 4 representing the food industry (2 very small companies, 2 small/medium companies); 2 representing academia (Extension educators with experience training food safety professionals in sanitation; and 1 representing a food safety

outreach non-profit) agreed to serve on the expert panel and general advisory board for the duration of the project. These experts were defined as professionals actively engaged in sanitation activities, whether through direct involvement (sanitarians) or indirect (managerial roles, overseers of operations staff, or academics that have taught sanitation programming in the past). Representation from the academic sector included universities and a non-profit education program intended for small food producers. Participation from the food industry included two different shared-use kitchen facilities, and two small food producers. The sanitation sector included participants from major chemical supply companies, and regulatory/consultancy firms associated with sanitation in food applications.

Survey development for modified Delphi approach

The eight university academics presented to the 11 expert panelists a virtual presentation via Zoom that described the overall need for this work and the subsequent proposed outcome of these research findings. The presentation identified problems, challenges, and opportunities associated with the lack of resources on food safety and sanitation and then presented the initial JTA structure. The presentation also introduced the value proposition for the JTA.

The Delphi surveys were developed and disseminated after the presentation concluded using Qualtrics (Provo, Utah) survey platform (25), a software program primarily used for data collection and analysis. After the presentation, the expert panel was then given time to review the complete Job Task list prior to completing the first round of survey responses (*Appendix 1*) and independently complete the first round of the Delphi questionnaire. Additionally, a link was sent via email for those who had to leave the meeting early. Each job task in the survey was identified as one that would be addressed either in online (asynchronous, self-paced) or in-person (hands-on) training. The survey asked experts to rank the degree to which they “agreed” or “disagreed” with the preliminary job roles and responsibilities list (*Appendix 2* includes the full Round 1 Delphi survey).

Online modules

The prospective job roles and job responsibilities that were to be addressed in the online modules were included in the questionnaire and ranked using a 5-point Likert scale (14), of varying levels from “strongly agree” (5) that our list included the correct job tasks for a respective role within a food safety system (operators/temporary hires, managers (quality managers, sanitarian, and plant managers), and CEOs or business owners), to “strongly disagree” (1) that our list included the correct job tasks for a respective role within a food safety system. Participants also had the opportunity to respond with (6) if they “did not know” or did not want to respond to that question. Participants were then allowed to add new job tasks to our list if they felt any were omitted.

Round 2 of the Delphi was prefaced with an updated draft of the JTA for each role, which was revised to include a more finite list of job roles and competencies based on survey results and add-on job tasks from round 1. Participants were asked to follow the same procedure again in round 2. Consensus (acceptance criterion) was based on a 75% agreement ranking, with a rating of “4” or greater.

In-person modules

The prospective job roles and responsibilities to be addressed in the in-person modules of our program were ranked differently than the online module content. The Delphi survey asked participants to use a ranking system (rank the 8 in-person topics on a scale from 1–8 in the first Delphi round), how important it was to include specific topics in our final programming. Rankings ranged from “extremely important to include this topic in our final in-person hands-on programming” (which would place the respective topic in 1st place out of 8) to “not important at all that the topic be included in our final in-person hands-on program” (which would place the respective topic in 8th place out of 8). Following the initial ranking questions, respondents were also asked to provide justifications and/or additions to the list. The study was composed of 2 rounds of questionnaires, such that after the 1st round, revisions were made to the original document based on consensus and open-ended text responses. Since a small population took the survey, and for programming length considerations, round 2 narrowed down the final list of hands-on topics from 8 to 6. The subsequent questionnaire (round 2) reflected these revisions, and the “final” format was presented to the panelists after analysis. Each questionnaire was examined by a team of 8 academics overseeing the study.

RESULTS

Delphi survey round 1

Participants were given a master list of job roles and responsibilities and asked to review the document before taking the Delphi survey. Of the 11 experts who initially agreed to participate, 11 surveys (100% response rate) were completed in Round 1 of the Delphi. After round 1 of the Delphi survey, the majority (10 out of 11 respondents, 90.9%) either strongly agreed (3 panelists) or agreed (7 panelists) that our team accurately conveyed the sanitation roles/responsibilities that Operators and Temporary Hires face in a food processing environment. One panelist indicated that they neither agreed nor disagreed. It was noted in the open-ended responses for this category that Operators/Temporary Hires are sometimes expected to do a lot more (non-sanitation, but roles pertinent to overall food safety) than what had been identified on the initial list, depending on the size of the facility. The second round Delphi survey did not account for this comment, since specific additional responsibilities could not be clearly identified.

Ranking for the Managers (Sanitarians, Plant Managers, or Quality Managers) job tasks were similar, showing that out of 11 respondents, the majority (9 out of 11 respondents, 81.8%) strongly agreed (2 participants) or agreed (7 participants) that the development team accurately conveyed the sanitation roles/responsibilities that managers face in a food processing environment. Two respondents disagreed that the development team accurately conveyed the sanitation roles/responsibilities that managers face in a food processing environment. One respondent mentioned that managers are frequently responsible for most sanitation tasks that require verification under Preventive Controls, as there are often no other qualified individuals on site, while the other respondent that responded “disagree” did not provide an explanation for their response.

The results for the CEO/Business Owners section of the job task list were met with varied opinions. Of the 11 respondents, 2 strongly agreed, 6 agreed, 1 neither agreed nor disagreed, and 2 disagreed that the job tasks accurately conveyed the sanitation roles/responsibilities that CEOs/Business Owners face in a food processing environment. Most open-ended justification responses noted that in their experience, the CEO is often absent in food safety management and that they have more of an overseer role in the business. Some noted that they have never had a food safety conversation with their CEO. [Table 2](#) below represents the job task list for the online module development after the first round of the Delphi. Consensus (acceptance criterion) was based on a 75% agreement ranking, with a rating of “4” or greater. In the first round of the Delphi, the only category where more than 75% of respondents did not answer with a 4 or greater was in the CEO/Business Owners section of the job task list. Because of this, open-ended survey responses were relied upon when determining which job tasks should stay on the list, which ones should be removed, and which ones should be moved to a different role/responsibility within the list.

When ranking topics the expert panel would like to include in our in-person program, 6 out of 11 participants ranked “how to physically clean and sanitize” as their top activity. “How to use tools to establish an effective cleaning and sanitation program” was ranked second; “How to calculate sanitizer concentrations” was ranked third; “How to calibrate monitoring tools” was ranked fourth; “How to use ATP or protein monitoring devices” was fifth; and “How to use facility records to verify your food safety plan and provide continuous improvement” was sixth. These top 6 responses were then ranked again in our Delphi round 2 survey.

Delphi survey round 2

Participants were provided a revised master list of job roles/responsibilities (the Job Task Analysis document after round 1 of the Delphi, [Table 2](#)) and asked to review the document before taking the Delphi survey again. Of the 11

experts who initially agreed to participate, 8 surveys (72.7% response rate) were completed in Round 2 of the Delphi. Because the survey was conducted anonymously, panelists (and their respective expertise) that did not participate in the second round of the Delphi cannot be determined. After round 2 of the Delphi survey, all participants (8) strongly agreed (4 panelists) or agreed (4 panelists) that our team accurately conveyed the sanitation roles/responsibilities that Operators and Temporary Hires face in a food processing environment. There were no open-ended justifications or responses in this part of the survey.

Results for the Managers (Sanitarians, Plant Managers, or Quality Managers) were similar, showing that out of 8 respondents, all participants either strongly agreed (1) or agreed (7) that the sanitation roles/responsibilities provided managers face in a food processing environment. There were no open-ended justifications or further responses in this part of the survey.

Results for CEO/Business Owners varied. Of the 8 respondents, all participants either strongly agreed (2), or agreed (6) that our team accurately conveyed the sanitation roles/responsibilities that CEOs/Business Owners face in a food processing environment. There were no open-ended justifications or further responses in this part of the survey.

Consensus (acceptance criterion) was based on a 75% agreement ranking, with a rating of “4” or greater. In the second round of the Delphi, all responses indicated a score of 4 or greater. Because of this, open ended survey responses were relied upon when determining which job tasks should stay on the list, which ones should be removed, and which ones should be moved to a different role/responsibility within the list. The list of job tasks after analysis of round 2 of the Delphi is included in [Table 3](#).

When ranking topics to include in the in-person program, 4 out of 8 participants ranked “How to physically clean and sanitize” as their top activity. “How to use tools to establish an effective cleaning and sanitation program” was ranked second; “How to calculate sanitizer concentrations” was ranked third; “How to calibrate monitoring tools” and “How to use ATP or protein monitoring devices” were tied for fourth. These top 4 topics were then used to develop our in-person hands-on SCPP ([Table 4](#)).

DISCUSSION

Inspectors are observing a massive uptick in sanitation non-conformances in inspection reports from facilities mandated by the Food Safety Modernization Act (FSMA) (32). With rising buyer demand leading to more food safety audits of processing facilities, there is a strong need to establish more accessible and effective sanitation training (16, 19, 23) thus eliciting the need for methods to develop more robust sanitation job task competencies. Identifying clear and accurate job tasks for a specific job sector has been noted as a critical aspect of developing accurate skills

TABLE 2. Job roles and responsibilities for sanitation workers in food processing facilities as identified by the Delphi expert panel (*n* = 11) after round 1 *

Role	Responsibilities/Job Tasks
Operator/Temporary Hire	1. [For wet cleaning/sanitation applications] Comply with the provided SOP that is the appropriate solution/chemistry (compound, temperature, concentration) for cleaning a food contact surface. 2. [For wet cleaning/sanitation applications] Comply with the provided SOP, which is an appropriate cleaning solution for cleaning out of place. 3. Identify and apply the appropriate utensils and/or equipment for cleaning a food contact surface. 4. Monitor sanitation effectiveness (i.e., visual observation, conducting sanitizer concentration test, and/or surface swabbing & recording results). 5. Establish and maintain records.
Managers (sanitarians, plant manager, quality manager)	1. Inspect preparation, processing, and storage areas (cleanliness & hygiene) for foods that are intended for public consumption. 2. Manage water sources that are in food preparation facilities for regulatory compliance. 3. Ensure that the staff are abiding by the SOP and/or FSP based on observations of team cleaning 4. Foster a positive food safety culture. 5. Establish and deliver appropriate training to the staff of a food production facility. 6. Support internal quality and safety investigations. 7. Perform testing for general sanitation monitoring as appropriate. 8. Evaluate results of tests and make appropriate decisions for further corrective actions. 9. Verify monitoring records and other appropriate records. 10. Effectively communicate with all colleagues as needed. 11. Develop and implement strategic sanitation program, policies, plans and processes to ensure that sanitary performance meets the business standards as well as supports food safety requirement towards regulatory compliance. 12. Manage sanitation chemical supply and inventory. 13. Maintain a safe work environment by properly implementing the IIPP (Injury Illness Prevention Programs) – always raise safety awareness for chemical handling and equipment operation with Lockout/Tagout training. 14. Maintain effective communication with subordinates, peers, and other members of management (Culture). 15. Lead internal quality and safety investigations. 16. Conduct root cause analysis on quality and safety related issues; ensure appropriate corrective actions. 17. Corrective actions are implemented and documented NOTE: Ensure that the company food safety guidelines are implemented daily (all GMPs but project scope is Sanitation).
CEO/Business Owner	1. Establish the roles and responsibilities of a cleaning and sanitation program. 2. Write cleaning and sanitation responsibilities into job descriptions, as relevant. 3. Establish, support, and codify a food safety culture.

*Experts were allowed to include open-ended narrative responses. Responses were quantitatively and qualitatively analyzed, and job tasks were either removed from the list entirely, moved to a different job role, or otherwise modified for clarity. See [Appendix I](#) for the full list of job tasks before the Delphi survey.

TABLE 3. Job roles and responsibilities for sanitation workers in food processing facilities as identified by the Delphi expert panel ($n = 11$) after round 2 *

Job Task	Operator/ Temporary Hire	Manager (Sanitarians, Plant Manager, Quality Manager)	CEO/Business Owner
Comply with an SSOP for cleaning a food contact surface.	X	X	X
Identify and apply the appropriate utensils and/or equipment for cleaning a food contact surface and non-food contact surface.	X	X	X
Perform sanitation monitoring activities.	X	X	X
Establish and maintain sanitation records.	X	X	X
Inspect preparation, processing, and food storage areas for cleanliness and hygiene.		X	X
Manage water sources that are in food preparation facilities for regulatory compliance.		X	
Establish and deliver appropriate training for the staff of a food production facility.		X	X
Support and/or lead internal quality and safety investigations.		X	X
Verify effectiveness of cleaning and sanitation by performing tests for monitoring as appropriate.		X	
Evaluate results of tests and make appropriate decisions for further corrective actions.		X	
Verify monitoring records and other appropriate records.		X	
Develop and implement strategic sanitation program, policies, plans and processes to ensure that sanitary performance meets the business standards as well as supports food safety requirement towards regulatory compliance.		X	X
Manage sanitation chemical supply and inventory.	X	X	
Conduct root cause analysis on quality and safety related issues, ensure appropriate corrective actions.		X	
Ensure corrective actions are implemented and documented. Ensure that the company food safety guidelines are implemented daily.		X	X
Establish the roles and responsibilities of a cleaning and sanitation program.			X
Write cleaning and sanitation responsibilities into job descriptions, as relevant.			X
Responsible for monitoring and verifying food safety systems are being implemented as designed.			X

*Experts were allowed to include open-ended narrative responses. Responses were quantitatively and qualitatively analyzed, and job tasks were either removed from the list entirely, moved to a different job role, or otherwise modified for clarity. This rendition of the job task list took into account that more than one role may be responsible for a certain task within a processing environment. See [Appendix I](#) for the full list of job tasks before the Delphi survey.

TABLE 4. In-person, hands-on topic final ranking after round 2 of Delphi (consolidated from 8 topics) *

Ranking	Topic
1	How to physically clean and sanitize
2	How to use tools to establish an effective cleaning and sanitation program
3	How to calculate sanitizer concentrations
4	How to calibrate monitoring tools, and use ATP or protein monitoring devices

*Experts were allowed to include open-ended narrative responses along with ranking. Responses were quantitatively and qualitatively analyzed, and topics were sequentially removed from the topic list based on expert feedback.

assessments and training curricula (1). Popular hiring boards such as Indeed™ have noted the importance of employers conducting internal JTA before hiring, as the process allows for detailed, comprehensive job descriptions that accurately reflect what the jobs entail (8). While numerous job descriptions exist for sanitation roles, none are standardized to identify core themes that address the growing number of sanitation non-conformances in the field. This study uses the balanced perspectives of both industry front-line employees and subject matter experts in the sanitation industry and academia to create a cohesive job task list. This final JT list and subsequent workbook aim to inform, guide and enhance the skills of food sanitarians. Furthermore, these resources enable businesses and training providers to assess sanitation employees' ideal and current performance in key competencies.

Like all aspects of food safety, operators and managers in food manufacturing facilities have various roles and responsibilities regarding sanitation. Open-ended responses from our Delphi surveys indicate that roles, especially roles of operators and temporary hires, are quite broad in the food industry. Although it is common for larger companies to have a dedicated sanitarian(s) to oversee their sanitation programs, smaller companies often do not (35). This is typically due to insufficient funding for a larger staff in small-scale operations (35). Sanitarians with experience and competency to perform specific sanitation skills often come with increased wages and other cost considerations. It is common for operators and managers to be engaged in both processing foods and pre- and/or post-operation cleaning and sanitation. In this project, the JT list was modified to include all major roles present in a food processing environment, from temporary hires to CEOs and managers. The JTs reported in this study provide a framework for all food safety managers, whether they are from big or small companies, to consider as they identify: 1) sanitation-related

responsibilities amongst their teams; 2) if current employees are being asked to do too much, (i.e., is there enough time in the day to produce product AND perform sanitation duties); 3) is it clear which roles are to be performed by who; 4) what, if any, are the sanitation related knowledge and skills gaps in the respective food facility; and 5) who would benefit from further training.

Limitations and opportunities

The future of food safety sanitation does not begin and end with the JTA presented in this work but opens various avenues for training growth. Identifying a JTA for sanitation not only impacts sanitation workers in the field (as a guideline for expectations of their food sanitation team) but sanitation training providers as well. The development team utilized the JTA presented in this work to develop a hybrid training that included online, and hands-on tiered program targeted at developing JTA skills and competencies. Furthermore, the JTA provides a future direction for the first ever sanitation credentialing system in the food safety space that recognizes competencies on targeted skills, much like other reputable food safety credentials available today for auditors (10, 20, 21, 22, 29). An accredited program would allow for more standardized methods for assessing and credentialing sanitation professionals.

The Delphi Method has been used globally in everything from clinical studies for identifying the best methods of treatment, to defining literacy in different languages, to identifying gaps in weighting systems for standardized tests, and more (2, 4, 12, 24, 28). However, the studies mentioned used large survey respondent pools, ranging from 100 to 300+ respondents in larger studies. Due to program length considerations, the developed training program did not provide the exhaustive JT list before the Delphi. Still, potential future adaptations of the program could consider all 33 original job tasks (Appendix I). We included 11 expert

panelists in our Delphi study, and some panelists were lost from the first to second survey responses. This lack of further input on the second round of the Delphi survey could be due to a plethora of contributing factors, such as our limited budget to compensate expert panelists for their time and effort on this project, time constraints, and survey fatigue. However, the reasons why members of the expert panel decided not to provide feedback to the second Delphi survey is unknown and was not investigated due to the anonymity of the survey. Ultimately, the small sample size did lead to a lack of significant variety and overall feedback on our JT list. Consensus (acceptance criterion) was based on a 75% agreement ranking, with a rating of “4” or greater. Throughout both rounds of the Delphi, the only category where more than 75% of respondents did not answer with a 4 or greater was in the CEO/Business Owners section of the job task list in the first round of the Delphi. Because of this, open ended survey responses were used to determine which JTs should stay on the list, which ones should be removed, and which ones should be moved to a different role/responsibility within the list. This required manual interpretation of open-ended feedback, which could have biased the final JT list. Future renditions of this work may take into account a higher acceptance criterion for a smaller sample size.

Studies in other fields have indicated that there is no official agreement on panel size for Delphi surveys or indicates that having between 8–15 panelists for a Delphi is sufficient (27). Although previously mentioned studies have had few participants like this study, future opportunities for this work could be to reproduce this study with more survey respondents (30–80). Because the Delphi takes into account opinions based on lived experiences of the expert panel, the results will never be entirely reproducible. Having a larger panel in the future would potentially achieve a more homogenous Delphi.

This study used a Modified Delphi to narrow down our initial sanitation JT list (33) to 18 most important job tasks, as determined by sanitation experts. The initial list of job roles and competencies was based on (1) current job postings in the field; (2) a review of the literature regarding sanitation shortcomings in the food industry, and (3) regulatory insight from past inspection reports in the field. It should be noted that there was no direct involvement from officials in the government sector of the food industry (such as lawmakers, FDA, or USDA representatives) in the Delphi survey, although there were regulators involved in this work. This limits the amount of direct government feedback achieved in this work, especially from representatives that make/regulate food safety laws. Despite this, it has been shown that top citations from recent public inspection reports include sanitation non-conformances such as “not cleaning and sanitizing utensils used in the production of food in a way that will control contamination”, “contact

times not being followed for surface chemicals”, “inadequate sanitation training for staff”, and “inadequate monitoring of sanitation conditions that could aid in contamination of a food product,” making the JTA an applicable tool for subsequent training materials.

In many states, sanitation training is not required, and processors only seek sanitation-related training when nonconformance is reported. Most training programs available do not contain hands-on activities to build on job task competencies, are primarily virtual, and are not based on academic and industry-advised competency needs (3, 6, 36). This gap was addressed by developing an informed JT list through a JTA via the Delphi method and using that analysis, along with frontline information, to create an interactive sanitation training program. This program includes an online component with interactive learning opportunities (Part I of the SCPP (23), and a Part II in-person component with multiple hands-on activities (10).

CONCLUSIONS

This study highlights the need to identify key JTs specific to the current roles and responsibilities of sanitarians in the food safety field. Despite the availability of job posting templates, a cohesive list of sanitation job tasks for curriculum development was absent. The JT list created here aims to support future sanitation programs by providing a concise list of responsibilities needing further training. A modified version of the Delphi method was used to identify the final list of JTs presented in this work. The JTs identified helped to pioneer a new sanitation course curriculum. Disseminating the hybrid program that includes online, and hands-on training provides accessible resources to the food safety workforce addressing sanitation nonconformances. The Modified Delphi and JTA methods have the potential to guide other curriculum developers in producing targeted training initiatives in the future.

ACKNOWLEDGMENTS

This material is based upon work supported by the National Institute of Food and Agriculture, U.S. Department of Agriculture, the Center for Agriculture, Food and the Environment, the Food Science department at the University of Massachusetts Amherst, under project number MAS00567, Food Science department at the University of Maine, the Food Science department at the North Carolina State University, the USDA Food Safety Outreach Program, project number USDA FSOP, Project #2021-70020-35685, and the USDA National Institute of Food and Agriculture, AFRI project NIFA 2023-67011-40346 FELLOWSHIP. The contents are solely the responsibility of the authors and do not necessarily represent the official views of the USDA or NIFA.

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APPENDICES

Appendix I. Initial job task list derived from literature reviews and sanitation job description analysis by primary project developer group.

Operator/Temporary Hires	1.) [For wet cleaning/sanitation applications] Determine the appropriate solution/chemistry (compound, temperature, concentration) for cleaning a food contact surface 2.) [For wet cleaning/sanitation applications] Prepare cleaning solution for cleaning out of place 3.) Identify and apply the appropriate utensils and/or equipment for cleaning a food contact surface 4.) Determine the appropriate chemistry for sanitizing a food contact surface 5.) Monitor sanitation effectiveness 6.) Visually observe cleanliness 7.) Take ATP measurements 8.) Determine whether food contact surface is ready for production based on ATP measurements 9.) Monitor concentration (PPM) of sanitizers
Sanitarian/Director of Sanitation	1.) Inspect preparation and storage areas for foods that are intended for public consumption. 2.) Monitoring water sources that are in food preparation facilities. 3.) Observing and TRAINING the staff of a food preparation facility. 4.) Investigating outbreaks that occur within the public and may be linked to a common source. 5.) Testing bacteriological and chemical levels in food preparation areas.
Operations Manager (Managerial Roles)	1.) Develops and implement strategic sanitation program, policies, plans and processes to ensure that sanitary performance meets standards as well as supports food safety requirement towards regulatory compliance 2.) Manages annual sanitation plan and performance 3.) Manage sanitation chemical supply and inventory 4.) Ensure that the plant is cleaned daily and ready to start production on time 5.) Maintain a safe work environment by properly implementing the IIPP (Injury Illness Prevention Programs) 6.) Ensure that food safety guidelines are implemented daily 7.) Maintain good communication with subordinates, peers and other members of management 8.) Train and set safety goals for sanitation crew. 9.) Participate in audits, facility inspections and coordinate pre-operational inspection with QC Management 10.) Clearly communicate expectation to sanitation employees.
Quality Manager	1.) Ensures that technicians are performing all daily sanitation responsibilities 2.) Trains all personnel in safe manufacturing practices and ensures that technicians are meeting all processing requirements 3.) Provides feedback to employees who are not completing responsibilities or violating sanitation requirements. 4.) Provides and leads sanitation solutions on problem areas and areas for improvement 5.) Provide training and feedback to operators on proper measurement, safe manufacturing practices, and food safety and sanitation methods. 6.) Documents SSOPs and monitor sanitation effectiveness
CEO/Business Owner	1.) Establish the roles and responsibilities of a cleaning and sanitation program 2.) Write cleaning and sanitation responsibilities into job descriptions, as relevant 3.) Deliver performance evaluations for employees implementing cleaning and sanitation actions

Appendix II. Job Task Analysis Delphi questionnaire that was disseminated to the expert panel.

After reviewing the Job Task Analysis (JTA) document, reflecting on your own experience with sanitation, and hearing the Advisory Board presentation, to what extent do you agree/disagree with the following. Select the “I do not know” option if you do not have experience with the topics stated in the JTA.

Q1. The team has included the appropriate Sanitation Related Roles in a small processing environment. (i.e., Operator/Temporary Hire, Managers (sanitarian, plant manager, quality manager), CEO/Business owner).

- ☐ Strongly agree (1)
- ☐ Agree (2)
- ☐ Neither agree nor disagree (3)
- ☐ Disagree (4)
- ☐ Strongly disagree (5)
- ☐ I do not know (6)

Display this question:

If The team has included the appropriate Sanitation Related Roles in a small processing environment.... = Neither agree nor disagree
Or If

The team has included the appropriate Sanitation Related Roles in a small processing environment.... = Disagree
Or If

The team has included the appropriate Sanitation Related Roles in a small processing environment.... = Strongly disagree

Q1A What Sanitation Job Roles do you think are missing from the JTA document?

Q2 OPERATOR/TEMPORARY HIRE Sanitation Related Job Tasks and responsibilities in a small processing environment are accurately conveyed.

- ☐ Strongly agree (1)
- ☐ Agree (2)
- ☐ Neither agree nor disagree (3)
- ☐ Disagree (4)
- ☐ Strongly disagree (5)
- ☐ I do not know (6)

Display this question:

If OPERATOR/TEMPORARY HIRE Sanitation Related Job Tasks and responsibilities in a small processing e... = Neither agree nor disagree

Or OPERATOR/TEMPORARY HIRE Sanitation Related Job Tasks and responsibilities in a small processing e... = Disagree

Or OPERATOR/TEMPORARY HIRE Sanitation Related Job Tasks and responsibilities in a small processing e... = Strongly disagree

Q2A What Sanitation Related Job Responsibilities do you think are missing from the OPERATOR/TEMPORARY HIRE section of the JTA document?

Q3 MANAGERS (SANITARIAN, PLANT MANAGER, QUALITY MANAGER) Sanitation Related Job Tasks and responsibilities in a small processing environment are accurately conveyed.

- ☐ Strongly agree (1)
- ☐ Agree (2)
- ☐ Neither agree nor disagree (3)
- ☐ Disagree (4)
- ☐ Strongly disagree (5)
- ☐ I do not know (6)

Display this question:

*If MANAGERS (SANITARIAN, PLANT MANAGER, QUALITY MANAGER) Sanitation Related Job Tasks and responsibilities.
= Neither agree nor disagree*

Or If

*MANAGERS (SANITARIAN, PLANT MANAGER, QUALITY MANAGER) Sanitation Related Job Tasks and responsibilities
= Disagree*

Or If

*MANAGERS (SANITARIAN, PLANT MANAGER, QUALITY MANAGER) Sanitation Related Job Tasks and responsibilities
= Strongly disagree*

Q3A What Sanitation Related Job Responsibilities do you think are missing from the MANAGERS (SANITARIAN, PLANT MANAGER, QUALITY MANAGER) section of the JTA document?

Q4 CEO/BUSINESS OWNER Sanitation Related Job Tasks and Responsibilities in a small processing environment are accurately conveyed.

- ☐ Strongly agree (1)
- ☐ Agree (2)
- ☐ Neither agree nor disagree (3)
- ☐ Disagree (4)
- ☐ Strongly disagree (5)
- ☐ I do not know (6)

Display this question:

If CEO/BUSINESS OWNER Sanitation Related Job Tasks and Responsibilities in a small processing enviro... = Neither agree nor disagree

Or If

CEO/BUSINESS OWNER Sanitation Related Job Tasks and Responsibilities in a small processing enviro... = Disagree

Or If

CEO/BUSINESS OWNER Sanitation Related Job Tasks and Responsibilities in a small processing enviro... = Strongly disagree

Q4A What Sanitation Related Job Responsibilities do you think are missing from the CEO/BUSINESS OWNER section of the JTA document?

Q5 The Sanitation program will include a hybrid model training which includes a self-paced online portion and a hands-on, in-person workshop. Based on the needs of your facility or the needs observed within your role, please rank the sanitation concepts below that warrant hands-on learning activities. Drag to move the concepts/topics to sequence them in order of importance, with 1 being the most important and 8 being least important.

- _____ How to build an SOP (Sanitation Operation Procedure) (1)
- _____ How to calibrate monitoring tools (I.e., pH meters, titrators, thermometers, etc.) (2)
- _____ How to take an environmental swabs and set up an environmental monitoring program (3)
- _____ How to calculate sanitizer concentrations (4)
- _____ How to use an ATP or protein monitoring device (5)
- _____ How to physically clean and sanitize (6)
- _____ How to use tools to establish an effective cleaning and sanitation program (7)
- _____ How to use facility records to verify your FSP and provide continuous improvement (8)

Q6 To what degree do you agree that these activities accurately reflect on your overall food safety program? Use the Go Back button to review the activities as necessary.

- ☐ Strongly agree (7)
- ☐ Agree (8)
- ☐ Neither agree nor disagree (9)
- ☐ Disagree (10)
- ☐ Strongly disagree (11)
- ☐ I do not know (12)

Display this question:

If To what degree do you agree that these activities accurately reflect on your overall food safety... = Neither agree nor disagree

Or If

To what degree do you agree that these activities accurately reflect on your overall food safety... = Disagree

Or If

To what degree do you agree that these activities accurately reflect on your overall food safety... = Strongly disagree

Q6B What Sanitation concepts were not included in this survey that you want to see in hands-on training modules?

Q7 Do you feel like this SCPP hybrid model is unique and meaningful? Please select your answers in the rating scale for each question: **Unique:** Is this hybrid-model course different from other sanitation courses that you have seen/experienced?
Meaningful: Would you be willing to spend time, energy, and money to go through this training program?

	Definitely not (1)	Probably not (2)	Might or might not (3)	Probably yes (4)	Definitely yes (5)	I do not know (6)
Unique (1)	☐	☐	☐	☐	☐	☐
Meaningful (2)	☐	☐	☐	☐	☐	☐

Display this question:

If Do you feel like this SCPP hybrid model is unique and meaningful? Please select your answers in t... = Definitely not

Or If

Do you feel like this SCPP hybrid model is unique and meaningful? Please select your answers in t... = Probably not

Or If

Do you feel liek this SCPP hybrid model is unique and meaningful? Please select your answers in t... = Might or might not