

**PROJECTING MEAT INDUSTRY CHARACTERISTICS  
IN THE 21ST CENTURY USING DELPHI:  
EXTRAPOLATING CURRICULUM CONTENT  
IN AGRICULTURAL EDUCATION**

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If educators are to prepare students to enter the society of the future as workers, then educational programs should be planned relative to the needs of these students upon graduation. Program developers must be futuristic in accessing the needs as they plan the curriculum that will be used to educate workers for the twenty-first century. Not only must the curriculum be futuristic to meet the needs for tomorrow but it must include instruction in content of the future. Traditionally, information about the past along with some knowledge of the present has been used as a base for planning. Today's information is often outdated by the time it is published and the skills being taught may not be applicable when the student enters the job market. The meat industry is an example of an area of agriculture that is changing at a very rapid pace. The industry is almost literally in a frenzy to see who can get ahead in technology. Yet, no research had been conducted as to the long range future of the meat industry. Vocational educators must use futuristic research as a means of keeping the meat curriculum current. This study utilized a futuristic means of research, the Delphi technique, which has been reported by many authors (Brown & Helmer, 1964; Cetron, 1969; Cyphert & Gant, 1970; Hill & Fowles, 1975; Reeves & Jauch, 1978; Swanson, 1981; Uhl, 1983; Weatherman & Swenson, 1974; Welch & Watson, 1979; and others), for selection of curriculum content in meat course work in agricultural education.

**Purpose and Objectives**

The primary purpose of this study was to determine curriculum content for meat course work in agricultural education in the year 2000, based on predicted characteristics of the meat industry. Specific objectives were to: determine the future characteristics of the meat industry, ascertain if the Delphi technique could achieve a consensus among meat experts as to the profile of the meat industry in the year 2000, predict the training needs of the work force entering the meat industry in the 21st century, and determine if demographic differences in respondents affected item ratings.

**Procedures**

This was a national study utilizing a modified Delphi technique. Weatherman and Swenson (1974) spoke of the adaptability of the Delphi to different disciplines, and Cetron (1969) indicated that the Delphi is often modified to meet specific objectives. The panel of experts from the meat industry and from academia were nominated by their peers at an international meeting, the 41st Annual Reciprocal Meat Conference. The 31 experts who were nominated the most frequently were invited to participate in the study. All agreed to participate by returning the completed first-round questionnaire. The data gathering instrument, which consisted of 98 items on a Likert-type scale, was used in both rounds one and two. Items for the questionnaire were developed by an extensive review of the current literature and through personal interviews. Of the 80 pertinent references, Topel (1986) best summarized the sentiments of the authors as follows:

We will see more changes in the meat industry in the next 15 years than we have observed in the last 40 years. The consumer is demanding a different type of meat product; these demands will result in major changes in management and marketing in the livestock and meat industry.

The instrument was reviewed for content and face validity by a seventeen-member panel who had expertise in research on meat, education, teacher education, and/or futures research. Respondents replied via mail to the two rounds of the modified Delphi instrument. Data collected in round one, including comments, were compiled and resubmitted to the 31 members of the panel of experts as a part of the round two instrument.

### Analysis of Data

Data analysis for this study consisted primarily of descriptive statistics including means, standard deviations, medians, and interquartile ranges. The Pearson product-moment correlation coefficient was used to measure stability between rounds, as cited in Cyphert and Gant (1970). A composite score was calculated for each item by taking the sum of the Likert scale score for all respondents. Consensus was reached on an item if sixty percent of the respondents were in agreement and the answer fell within either the "agree" or "disagree" range. The researchers used logic to interpret the findings in order to draw conclusions and make recommendations for course content areas.

### Results

The 31 members of the panel of experts were all males, ranging in age from 36 to 72 years with a mean of 50 years. Seven of the experts held management positions in industry or related support organizations. The remaining 24 experts were faculty and/or administrators of meat science at universities. Many had both university and industry experience. All but two of those selected to the panel of experts had Ph.D. degrees. All 31 panel members returned both round one and round two instruments. In addition, the respondents made 811 comments on the various items.

A composite score was calculated on round two data for each item and used to rank the items in order of agreement. The highest ranked items dealt with animal welfare, product quality, consumer education, and convenience of preparation. The items ranked lowest—indicating disagreement—were concerned with use of current but little used technology in the future, location of processing, increasing lamb consumption, retention of livestock ownership by producers, and consumers shopping for generic protein sources. These data may be viewed in Table 1.

Items were measured against the two criteria to determine consensus. Twenty-five items (26%) did not meet the criteria for consensus. Of the 73 items on which consensus was reached, seven items (10%) were in the "disagree" range and 66 items (90%) were in the "agree" range.

Several statistical procedures were performed on the data to determine convergence of opinion and stability of responses. Means, medians, standard deviations and interquartile ranges were calculated for each item in rounds one and two. However, medians and interquartile ranges were more appropriate as measures of convergence of opinion due to the skewed nature of the distribution of expert responses (Glass & Hopkins, 1984). In 92 of the 98 items (94%) the interquartile range in round two was slightly smaller than in round one. In only one case did the interquartile range increase, and in five cases it remained the same. The mean change in the interquartile range from round one to round two was -0.163.

Stability of the responses from round one to round two was measured using Pearson product-moment correlations. The responses were found to be very stable on all 98 items. This was indicated by the magnitude of correlation, which was examined according to Cohen's (1988) power analysis, in which a small  $r = .10$ ; medium  $r = .30$ ; and large  $r = .50$ . All but one item were large in magnitude, (.50 to 1.00 correlation); the item which was medium in magnitude of correlation was approaching large at  $r = .487$ .

These results indicated that further rounds of the Delphi technique would have been of little benefit, and may even have been detrimental. Reeves and Jauch (1978) found that going beyond two rounds may result in loss of response, which raises the threat of mortality to the validity of a study.

### Conclusions

Use of the Delphi Technique: The Delphi technique may be efficiently used to determine consensus among meat industry experts. These findings about the future characteristics of the industry are essential to developing meat curriculum content for the future. The respondents, regardless of geographic location, age, or education level were in basic agreement on the item ratings.

Characteristics of the Meat Industry in the year 2000: The following statements represent the meat industry of the future, according to the expert panel:

1. The meat industry will change rapidly in the future with more emphasis on automation technology.

Table 1  
Items of Greatest and Least Agreement, Ranked by Composite Score on Round Two

Item Number	Statement	Composite Score	Rank Order
<b>Items of Greatest Agreement</b>			
47.	The livestock industry can expect increasing pressure from animal welfare groups.	149	1
28.	Food service operators in the 21st century will look for quality factors of food such as consistency, uniformity, and product value.	149	2
42.	Senior citizens, demanding a versatile number of food offerings, will become extremely important consumer targets.	146	3
32.	Consumers will consider nutrition in their food purchasing decisions but they will not buy a product more than once if its taste, smell, color, etc. are not acceptable.	146	4
49.	The better managed companies will make discretionary inspection work for them.	143	5
<b>Items of Least Agreement</b>			
74.	The use of irradiation/sterilization of vacuum-packed meats will be used to extend shelf life at room temperature.	74	94
10.	Animals will be slaughtered at one location and processed at another location; these may be by different companies.	72	95
36.	Lamb consumption will increase due to improved marketing techniques such as better fabrication.	70	96
3.	Producers will retain ownership of cattle throughout the cycle. In some cases this ownership will be extended to specified retail outlets.	67	97
46.	Consumers will shop for generic protein sources rather than specific meats such as beef, pork, chicken, turkey, fish, or other meats.	58	98

2. Education will play an extremely important role in the meat industry, creating jobs in the consumer education field. Consumer education will begin in grade school to put into perspective the relationship of nutrients and hormones to our diet. Consumers will demand and be able to utilize nutritional information at the retail market and in restaurants. Retail meat merchandisers will spend more time with specialty items and consumer education and less time processing meat. The scientific and health care communities will require aggressive training and retraining based on accurate and detailed information to change consumer attitudes as to how red meat fits into diets.
3. Management of large, diversified companies will utilize a team approach.
4. Consumer demands will include consistency, uniformity, less fat, lighter batters, product value, and nutritious products that are still pleasing to the organoleptic senses. The experts disagreed that consumers would shop for generic protein sources rather than specie specific or combined sources.
5. Packaging of meat products will consider the following: smaller single-service portions; and convenient, microwaveable, easy to open, aesthetically pleasing

packages. More pre-packaged meat (fresh, pre-cooked and/or frozen) will be seen in the retail case utilizing technology similar to skin packaging. The success of pre-packaging systems will depend on the education of personnel in the distribution system.

6. Marketing strategies should consider target groups as opposed to the overall population to stimulate sales.
7. Retailers will buy pre-trimmed meats in case-ready or in subprimal form. Many of these products will be pre-packaged, brand-identified, value-added products that may have been prepared at a central commissary.
8. Livestock producers will supply lean carcasses while maintaining excellent palatability traits. Cattle will be sold on a value-based system.
9. Research will continue into the 21st century in the following areas: molecular genetics to improve carcass composition, growth, and palatability; other biotechnology to improve fermentation processes, and to eliminate oxidative rancidity; and increased studies of consumer trends.

#### **Recommendations**

Agricultural Education curricula for meat course work needs to be expanded beyond identifying retail cuts and placing carcasses in contests. The meat industry has become a technological giant requiring many job skills. Therefore, students in vocational education meat programs should be exposed to career opportunities and trade terminology. They should also be trained in using applied math, physics, and general science. Exercises in problem solving for management, production, economics, maintenance, scheduling, and quality assurance should be implemented. Students should be made aware of environmental safety, worker safety, and inspection requirements. Stimulating assignments should be developed using situations such as hypothetical product development from conception to consumer use. The 23 content areas listed below should be considered in developing or improving a meat curriculum of the future for agricultural education:

- Product formulation and ingredients
- Use of the computer in formulation and inventory control
- Product selection based on dietary information and price
- Problems in yield determination
- Demographic survey techniques
- Principles of equipment maintenance
- Conversion of muscle to meat
- Meat quality factors
- Meat cookery
- Management approaches
- Quality control techniques
- Meat plant sanitation and its effects
- Problems associated with the central processing of meats
- Meat plant design
- Packaging principles and materials
- Product labeling
- Sensory evaluation of foods
- Meat marketing in a service-oriented society
- New marketing factors for livestock
- Job tasks in the meat industry
- Products and by-products of the meat industry
- Current trends and issues in meats
- Profile of a meat snack food

#### **Suggestions for Further Study**

Further research should be conducted to more specifically determine futuristic trends in different segments of the meat industry (e.g. marketing, packaging, etc.). Studies should be conducted to relate present consumer beliefs about the nutritional value of meat to the actual facts, and, to

determine industry acceptance of training and retraining programs at the post-secondary level, along with input from the industry as to course content to train future employees.

The voluminous comments collected from the panel of experts should be further analyzed in terms of the item ratings. A replication of this study should be conducted every five years to see, a) how the future of the meat industry is then perceived, and b) what changes have occurred in the meat industry.

#### References

Brown, B. & Helmer, G. (1964). Improving the reliability of estimates obtained from a consensus of experts (P-2986). Santa Monica, CA: RAND Publications.

Cetron, M. J. (1969). Technological forecasting. New York: Gordon and Breach.

Cohen, J. (1988). Statistical power analysis for the behavioral sciences. (2nd ed.). Hillsdale, New Jersey: Lawrence Erlbaum Associates.

Cyphert, F. R. & Gant, W. L. (1970). The Delphi technique: A tool for collecting opinions in teacher education. The Journal of Teacher Education, 21, 417-425.

Glass, G. V. & Hopkins, K. D. (1984). Statistical methods in education and psychology (2nd ed.). Englewood Cliffs, NJ: Prentice-Hall.

Hill, K. Q. & Fowles, J. (1975). The methodological worth of the Delphi forecasting technique. Technological Forecasting and Social Change, 7, 179-192.

Reeves, G. & Jauch, L. R. (1978). Curriculum development through Delphi. Research in Higher Education, 8, 157-168.

Swanson, G. I. (Ed.). (1981). The future of vocational education. Arlington, VA: American Vocational Association.

Topel, D. G. (1986). Future meat-animal composition: industry adaptation of new technologies. Journal of Animal Science, 63, 633-641.

Uhl, N. P. (Ed.). (1983). Using research for strategic planning. San Francisco: Jossey-Bass.

Weatherman, R., & Swenson, K. (1974). Delphi technique. In S. P. Hencley and J. R. Yates (Eds.), Futurism in education: Methodologies (pp. 97-114). Berkeley, CA: McCutchan.

Welch, H., & Watson, S. E. (1979). Techniques of futures research. In F. R. Brodzinski (Ed.), Utilizing futures, research (pp. 1-9). San Francisco: Jossey-Bass.