Swine industry stakeholder perceptions of precision livestock farming technology: A Q-methodology study

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Abstract

This study used Q methodology to analyze perceptions of precision livestock farming (PLF) technology held by stakeholders directly or indirectly involved in the swine industry. We identified three distinct points of view: PLF improves farm management, animal welfare, and laborer work conditions; PLF does not solve swine industry problems; PLF has limitations and could lead to data ownership conflict. Stakeholders with in-depth knowledge of PLF technology demonstrated elevated levels of optimism about it, whereas those with a basic understanding were skeptical of PLF claims. Despite holding different PLF views, all stakeholders agreed on the significance of training to enhance PLF usefulness perceptions and its eventual adoption. In conclusion, we believe the study's results hold promise for helping the swine industry stakeholders make better-informed decisions about the PLF technology implementation.

Keywords: precision livestock farming, Q-methodology, stakeholder, swine industry

Introduction

Three features of the existing swine production systems in developed countries have consistently drawn criticism from the public: animal welfare (Richards et al., 2013), the environment (Sato et al., 2017), and food safety (Clark et al., 2016). These societal worries are partly due to the global pig industry's shift from small, outdoor herds to large intensive indoor systems (Kittawornrat and Zimmerman, 2011). The elevated level of attention that intensive pig production has received from stakeholders outside the swine industry (mostly on the quality of pig life) has led to significant changes in how pigs are housed and cared for.

One of the significant changes in how pigs are raised is the growing use of Precision Livestock Farming (PLF) technologies. PLF involves using technology to continuously collect and process data from individual animals (Berckmans, 2017). Precision livestock farming technology has recently been proposed as a solution to help address public concerns transparently and objectively (Morrone et al., 2022). Despite several claimed PLF benefits, there is limited empirical evidence to back up its applicability to various swine industry stakeholders. Particularly, information on what PLF means to different stakeholders, its adoption, benefits, concerns, and limitations is lacking (Giersberg and Meijboom, 2021).

This study examined swine industry stakeholders' perceptions of and needs for PLF across the pig production system ranging from genetic improvement to welfare certification. We adopted the Q methodology to quantify swine stakeholders' perceptions of PLF technology. The growing recognition that the opinions of stakeholders involved in the development and usage of technology must be considered for decisions to be recognized as legitimate is a major factor in the Q methodology's rising popularity in technology-related studies (Choi and Moon, 2023; Yenilmez Turkoglu et al., 2022; Gauttier, 2022).

Materials and methods

The Q-methodology combines quantitative and qualitative techniques to examine people's subjective beliefs scientifically and enables researchers to statistically identify and categorize the opinions on a given topic (Brown, 1996). In a Q study, an individual is presented with a set of statements about a given topic and then asked to rank-order the statements (in this study, from "Most Like What I Think" to "Least Like What I Think "), an operation referred to as Q sorting. The Q methodology procedure is briefly described here. The first stage in this study was to establish the Q-Sample (i.e., questions), which entails identifying the survey items. The collection of survey items is referred to as a concourse (from the Latin concursus, meaning "a running together" as when ideas run together in thought) (Brown, 1993), and it is from this concourse that a sample of statement samples are later drawn from for use in a Q sort. We developed a concourse by interviewing 12 stakeholders with varied swine industry backgrounds. In the interviews, we pursued five major themes, namely: the meaning, adoption, benefits, concerns, and PLF limitations with which we generated 30 statements for the Q-sort exercise (see Appendix 1). In stage 2, stakeholders with diverse perspectives ranging from pig conception (producers) to pork consumption (consumers) were purposefully chosen. Eleven of the 12 participants who initially participated in the initial interviews completed the Q-sort. Participants were experts in swine welfare, swine veterinary medicine, animal welfare auditing, animal health regulation, technology development, agricultural engineering, animal care and compliance, animal breeding and genetics, and consumer advocacy. The demographic characteristic of the participant is shown in Table 1. Stage 3 involved administering the Q-Sort to the 11 participants (1 participant from the interview dropped off). The Q sort was concurrently administered to nine participants in person while 2 joined online via Zoom. The condition of instruction (see Appendix 2) for the Q-sort was read and demonstrated to all the participants who were also given the chance to ask clarifying questions. The Q sorting lasted for about 30 minutes. During the Q sorting, participants were given a set of 30 index cards. Each index card had one of the 30 concourse statements written on it and randomly numbered.

They were given the Q-sort grid (Figure 1) with the condition of instructions. They were first asked to sort the cards into three piles of "More Like What I Think," "Least Like What I Think," and "Neutral (statements for which participants had no opinion)," based on their opinion of PLF. Next, they were given the Q-sort grid in Figure 1, on which they ranked the different statements on a 30-item forced normal distribution ranging from +5 (More Like What I Think) to −5 (Least Like What I Think). Participants began by taking the statements they grouped as "More Like What I Think" and choosing the one statement that was "most like what I think" to place on the worksheet in the "+5" column on the far right. They were then asked to place the next two statements "More Like What I Think" into the "+4" column (in particular no order) until all statements from their "More Like What I Think" pile were placed on the Q-sort grid. The process was repeated with "Least Like What I Think" statements, starting with a statement in the "−5" column.

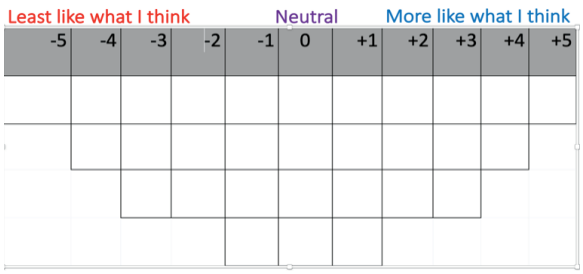

Figure 1: Q Sort Grid

Finally, when the participants were satisfied with how they had arranged the concourse statements on the Q-Sort grid, they wrote the number on the statement card inside the corresponding squares in the Q-Sort

grid. A completed Q-sort grid is shown in Appendix 6a-6c. Finally, participants provided basic demographic information (Table 1).

Table 1: Participants' demographics

Work Experience (years)	Organizational role	Position
26-30	Veterinary services	Owner
10-Jun	Welfare certification & regulation	Director animal care compliance
31 or more	Food retailing and regulation	Executive
10-Jun	Welfare certification and compliance	Consumer services and program record manager
15-Nov	Technology development and farming	Chief technology officer
16-20	Technology development, veterinary services and pharmaceutical	Director
31 or more	Technology development	Director
16-20	Professional association	Associate editor
31 or more	Government regulation	Leader
15-Nov	Academic and research institution	Senior researcher
31 or more	Academic and research institution	Professor

Gender and level of education were omitted to preserve participants' anonymity

Table 2: Unrotated and rotated solutions of participants Q-Sorts

	Unrotated solution			Rotated solution		
Participants/Q-Sorts	Factor 1	Factor 2	Factor 3	Factor 1	Factor 2	Factor 3
P1	**0.85**	0.06	-0.17	**0.57**	**-0.51**	0.2
P2	**-0.49**	**0.64**	-0.30	**0.73**	0.02	0.19
P3	**0.79**	0.27	-0.06	-0.1	**0.87**	-0.03
P4	**-0.57**	**0.61**	-0.28	-0.01	**0.86**	-0.01
P5	**0.81**	-0.32	-0.04	**0.62**	**-0.59**	-0.17
P6	0.39	**0.68**	0.22	**0.79**	-0.37	0.08
P7	**0.78**	-0.07	0.08	**0.55**	**-0.68**	-0.02
P8	**0.79**	0.36	-0.24	**0.76**	-0.21	0.28
P9	0.37	0.43	**0.73**	0.46	0.22	**0.63**
P10	**0.62**	0.39	-0.20	**0.88**	-0.08	0.17
P11	**0.78**	-0.30	-0.23	0.11	-0.13	**0.91**
% Eigenvalue	5.10	1.97	0.95	3.75	2.82	1.45
% Explained Variance	46	18	9	34	26	13

In stage 4, data from the Q-Sorts was analyzed using the free software PQMethod (Peter Schmolck, http://schmolck.org/qmethod/). First, a principal components analysis (PCA) was performed to correlate the Q-Sorts. By default, the analysis produces eight unrotated factors, which accounted for 95% of the total variance in the Q-Sorts. Second, a varimax rotation was used to identify a small number of factors with significant factor loadings. Following Brown (1980) we determined the number of factors to rotate based on: (1) the eigenvalue is equal to or greater than one; (2) each factor should have at least two significant

factor loadings in the unrotated factor matrix. Two of the eight factors met both criteria (Table 2). The third factor was included in the rotation because its eigenvalue was close to one (0.94), and satisfied Humphrey's Rule, which states that a factor is significant if the absolute value of "the cross-product of the two highest loadings exceeds the standard error" (Watts and Stenner, 2012). After rotating the three factors (see Table 2), we found that at least two participants were loaded on each factor, the eigenvalue of the three factors was higher than one, and the three factors accounted for 73% of the total variance. In Table 2, factor loadings in bold are significantly associated with each factor. A sort is significantly associated with a factor at 0.01 statistical significance if the absolute value of the factor loading is greater than 0.47 (Brown, 1980). The last step in the Q-analysis consisted of estimating factor scores for each statement on all factors and identifying distinguishing statements (i.e., statements that were ranked significantly different between a given factor and the other two factors) and consensus statements (statements that were ranked similarly between a given factor and the other two factors) for each factor.

We focused the interpretations of the factor analysis on the rotated solution factor Q-Sort values. For each factor, we considered the statements with the highest and the lowest Q-Sort values (see Tables 3-5). The highest-ranking statements (i.e., Q-Sort values that are between 3 and 5) indicate what participants who loaded on the factor of interest think of PLF technology and least like what participants think for the lowest-ranking statements. We also paid close attention to the distinguishing statements (see Appendix 5) which are the statements that were found to be significantly different among factors. The Consensus statements (Appendix 5) were also found to be helpful in identifying the PLF-related issues that all participants could agree on even though they loaded on varied factors.

Results and discussion

Table 2 shows the factor loadings of the participants. Factor loadings of more than 0.47 are considered significant ($p<0.01$). Based on the results in Tables 3-5 and Appendixes 4-6, three perspectives were identified: (1) "PLF improves management, animal welfare, and laborer work conditions", (2) "PLF does not solve the problems", and (3) "PLF has limitations and could lead to data ownership conflict".

Perspective 1: PLF improves management, animal welfare, and labor work condition

Seven participants with positive factor loadings loaded positively and significantly onto Perspective 1, which was drawn from Factor 1. Among the participants sharing Perspective 1 were 3 technology developers, 2 swine veterinarians, a swine farmer, and an animal care and compliance specialist. Perspective 1 is distinctly different from Perspectives 2 and 3 in that participant who shares this perceptive think PLF technology will improve swine farm management, improve pig health, welfare, and laborer work conditions affirming previous findings by Banhazi (2013). This perspective sees PLF as a supplement to good animal husbandry but should not replace caregivers. Those represented by Perspective 1 think PLF will help in controlling disease outbreaks through traceability. The Perspective 1 stakeholder has practical knowledge of PLF and is fully aware of the values and potential of PLF technology, which explains their high optimism about PLF benefits to the swine industry. The "most and least like what I think" statements for Perspective 1 are summarized in Table 3. Overall, Factor 1 focuses on management, animal, and labor issues. The statement "PLF technology should be a supplement to good management and not replace good management" with the highest factor score of "5" is the most important to participants in this group. It is noteworthy that participants in Perspective 1 did not see PLF as disconnecting caretakers from pigs and making them less caring; as making PLF data unusable within existing farm management practices; as generating data that conflicts with farmer expert opinions; and as displacing labor and reducing job opportunities in the swine industry.

Table 3: More and least like what participants in Perspective 1 think of PLF.

Scores	Statements
5	PLF technology should be a supplement to good management and not replace good management
4	PLF technology will improve pig health
4	PLF technologies make the pig caretaker's job easier, safer, and better
3	PLF technology will improve pig welfare
3	PLF technology will help in controlling disease outbreaks through traceability
-3	PLF technologies are displacing labor and reducing job opportunities in the swine industry
-3	PLF technology often generates data that conflict with farmer expert opinions thus making PLF data less useful
-4	PLF technologies can be used without any form of training
-4	PLF technology can disconnect caretakers from pigs and make them less caring about pigs
-5	PLF technologies' data often cannot be used within existing management practices

Table 4: More and least like what participants in Perspective 2 think of PLF.

Scores	Statements
5	PLF technology can disconnect caretakers from pigs and make them less caring about pigs
4	PLF technology is a poor proxy of a farmer looking over the herd, detecting

Score = 3). Stakeholders in the Perspective 2 group feel that PLF technology should be used in conjunction with effective management, not as a replacement for it (Factor Score = 3). Finally, respondents favoring Perspective 2 were pessimistic about the claims that PLF can improve pig welfare (Factor Score = -5) and pig health (Factor Score = -4). There is also skepticism among Perspective 2 participants that PLF will allay public concerns, boost consumer confidence in pork production, and enable consumers to independently verify welfare certification claims. However, persons supporting Perspective 2 also think PLF technology cannot be used without training.

Perspective 3: PLF limitation and data ownership conflict

Perspective 3 drawn from Factor 3 focused on "PLF limitation and data ownership conflict" (Table 5). Like PLF adoption barriers reported by Banhazi et al. (2022) and Makinde et al. (2022), stakeholders in this group considered poor internet connection a major problem on most swine farms. They also believed that PLF usage can lead to data privacy and ownership conflicts. In contrast to the Perspective 1 group, they believed PLF data cannot be utilized within current management practices and that it will take substantial modification to adapt current production system processes to fully utilize PLF data. Stakeholders in Perspective 3 concurred with Morrone et al. (2022) that PLF technologies are too expensive and may reduce the profitability of farming operations. In line with Perspectives 1 and 2, Perspective 3 stakeholders see the need for training to effectively utilize PLF technology, echoing Banhazi et al. (2022). They rejected the claim that PLF technology would allay public worries and boost consumer confidence in pork production. They neither see PLF technology as a solution to labor problems nor as displacing labor and reducing job availabilities in the swine industry. Likewise, they did not see PLF technology as a poor proxy for a farmer detecting problems and addressing them.

Table 5: More and least like what participants in Perspective 3 think of PLF.

Scores	Statements
5	PLF technology usage is limited by poor internet connection on most swine farms
4	PLF technology usage can lead to data privacy and data ownership conflicts
4	PLF technologies' data often cannot be used within existing management practices
3	PLF technologies are cost-prohibitive to use across the entire livestock system
3	PLF technologies require a significant effort to change processes within an existing production system
-3	PLF technologies are displacing labor and reducing job opportunities in the swine industry
-3	PLF technology will address labor shortages in the swine industry
-4	PLF technology is a poor proxy of a farmer looking over the herd, detecting problems, and addressing them
-4	PLF technology will address public concerns and increase consumer trust in pork production
-5	PLF technologies can be used without any form of training

Conclusions

This study set out to investigate how persons with varied involvement in the swine industry see precision livestock farming technology. Three distinct viewpoints were identified by the study using the Q methodology: PLF improves farm management, animal welfare, and labor work condition; PLF does not solve swine industry problems; PLF has limitations and could lead to data ownership conflict. The results uncovered the diversity of perspectives held by swine stakeholders about PLF technology and provided common descriptions of viewpoints. We noticed similarities in stakeholder opinions with direct and indirect PLF knowledge. Stakeholders with direct and advanced knowledge of PLF technology displayed high

optimism about PLF technology whereas stakeholders with indirect and limited knowledge tend to be skeptical of PLF claims. The study emphasized the significance of training to enhance perceptions of PLF's usefulness and its eventual implementation.

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Appendix 1: 30 statements for Q set

No	Statements
1	PLF technology is a poor proxy of a farmer looking over the herd and detecting problems and addressing them
3	PLF technologies can be used without any form of training
4	PLF technology will improve pig health
5	PLF technology will improve pig welfare
6	PLF technology will help in controlling disease outbreaks through traceability
7	PLF technologies can lower the cost of pork production
8	PLF technologies are cost-prohibitive to use across the entire livestock system
9	PLF technology will increase swine producers' profit margin
10	PLF technology may digitize swine production and make it look less natural and more artificial
11	PLF technology usage can lead to data privacy and data ownership conflicts
12	PLF technology can disconnect caretakers from pigs and make them less caring about pigs
13	PLF technology will make it possible for consumers to verify welfare certification claims
14	PLF technology may discourage pork consumption because it is probably profitable on large farms which some
16	PLF technology does not minimize the environmental impact of swine farming
17	PLF technologies are not as precise as technology development companies claim them to be
18	PLF technology usage is limited by poor internet connection on most swine farms
19	PLF technologies' data often cannot be used within existing management practices
21	PLF technologies make the pig caretaker's job easier, safer, and better
22	PLF technologies are displacing labor and reducing job opportunities in the swine industry
24	PLF technology should be a supplement to good management and not replace good management
25	PLF technology is an environmentally friendly production system
27	PLF technology will enable producers to accurately plan their feed conversion ratio (FCR) upfront
29	PLF technology is not necessarily useful to small-scale farmers operating outdoor mixed housing system
30	PLF technology often generates data that conflict with farmer expert opinions thus making PLF data less useful

Appendix 2: Q-Sort condition of instruction

Conditions of instructions for PLF 30 statements Q sorting

A Study on Precision Livestock Farming

In this study, we are interested in your opinion about Precision Livestock Farming (PLF). You will be asked to order 30 cards that contain statements based on what PLF means to you. Rank and order the statements according to least or most like what you think of PLF. We are only interested in your opinions, so there are no right or wrong answers.

Instructions

1. There are 30 cards numbered from 1 to 30. As you read the statement on each card, sort them into three piles:
   - most like what I think;
   - least like what I think; and
   - neutral (statements of which you have no opinion)
2. From the "most like what I think" pile, select one card which you think is the most important and place the card in the box under column +5.
3. From the remaining cards in the "most like what I think" pile, select two cards that you think are the next most important and arrange them in the boxes (in no particular order) under column +4.
4. From the remaining cards in the "most like what I think" pile, select three cards that you think are the next most important and arrange them in the boxes (in no particular order) under column +3.
5. From the remaining cards in the "most like what I think" pile, select three cards that you think are the next most important and arrange them in the boxes (in no particular order) under column +2.
6. From the remaining cards in the "most like what I think" pile, select four cards that you think are the next most important and arrange them in the boxes (in no particular order) under column +1.

   You may find that you do not have enough cards to completely fill these columns. In that case, pick cards from the neutral pile to fill in the columns. In the event that you have too many cards, place the extras in the neutral pile.
7. Now from the "least like what I think" pile, select one card which you think is the most important and place the card in the box under column -5.
8. From the remaining cards in the "least like what I think" pile, select two cards that you think are the next most important and arrange them in the boxes (in no particular order) under column -4.
9. From the remaining cards in the "least like what I think" pile, select three cards that you think are the next most important and arrange them in the boxes (in no particular order) under column -3.
10. From the remaining cards in the "least like what I think" pile, select three cards that you think are the next most important and arrange them in the boxes (in no particular order) under column -2.
11. From the remaining cards in the "least like what I think" pile, select four cards that you think are the next most important and arrange them in the boxes (in no particular order) under column -1.

    You may find that you do not have enough cards to completely fill these columns. In that case, pick cards from the neutral pile to fill in the columns. In the event that you have too many cards, place the extras in the neutral pile.

Finally, arrange the cards in the neutral pile in the boxes (in no particular order) under column 0. When you are finished, you should have no cards left and no blank spaces on the grid. If you wish to change the position of certain cards, you may do this at any time.

Appendix 3: Correlation matrix of study participants

	P6	P4	P8	P3	P7	P9	P1	P10	P11	P2	P5
P6	100	-29	75	-38	73	28	58	64	24	50	60
P4	-29	100	-21	59	-54	5	-46	-7	-3	-4	-50
P8	75	-21	100	-25	46	43	58	64	34	50	52
P3	-38	59	-25	100	-62	17	-46	-18	-17	-17	-54
P7	73	-54	46	-62	100	17	55	62	14	24	68
P9	28	5	43	17	17	100	25	48	43	32	9
P1	58	-46	58	-46	55	25	100	49	25	50	56
P10	64	-7	64	-18	62	48	49	100	31	62	58
P11	24	-3	34	-17	14	43	25	31	100	28	4
P2	50	-4	50	-17	24	32	50	62	28	100	38
P5	60	-50	52	-54	68	9	56	58	4	38	100

Appendix 4: Factor arrays

		Factors		
No.	Statement	1	2	3
1	PLF technology is a poor proxy of a farmer looking over the herd and detecting problems and addressing them	-3	4	-4
2	PLF technologies cannot manage individual pigs on commercial farms	-2	1	0
3	PLF technologies can be used without any form of training	-4	-4	-5
4	PLF technology will improve pig health	4	-4	0
5	PLF technology will improve pig welfare	3	-5	2
6	PLF technology will help in controlling disease outbreaks through traceability	3	-2	-1
7	PLF technologies can lower the cost of pork production	2	-3	-1
8	PLF technologies are cost-prohibitive to use across the entire livestock system	-1	1	3
9	PLF technology will increase swine producers' profit margin	1	0	0
10	PLF technology may digitize swine production and make it look less natural and more artificial	-2	3	-2
11	PLF technology usage can lead to data privacy and data ownership conflicts	-1	0	4
12	PLF technology can disconnect caretakers from pigs and make them less caring about pigs	-4	5	-2
13	PLF technology will make it possible for consumers to verify welfare certification claims	2	-3	2
14	PLF technology may discourage pork consumption because it is probably profitable on large farms which some	0	2	-1
15	PLF technology will ensure producers are transparently accountable to consumers	1	-2	0
16	PLF technology does not minimize the environmental impact of swine farming	-2	4	-3
17	PLF technologies are not as precise as technology development companies claim them to be	0	0	2
18	PLF technology usage is limited by poor internet connection on most swine farms	2	2	5
19	PLF technologies' data often cannot be used within existing management practices	-5	0	4
20	PLF technologies require a significant effort to change processes within an existing production system	-1	1	3
21	PLF technologies make the pig caretaker's job easier, safer, and better	4	-1	3
22	PLF technologies are displacing labor and reducing job opportunities in the swine industry	-3	1	-3
23	PLF technology will address labor shortages in the swine industry	1	-1	-3
24	PLF technology should be a supplement to good management and not replace good management	5	3	1
25	PLF technology is an environmentally friendly production system	1	-2	-2
26	PLF technology will address public concerns and increase consumer trust in pork production	-1	-3	-4
27	PLF technology will enable producers to accurately plan their feed conversion ratio (FCR) upfront	0	-1	1
28	PLF technologies on a farm are made by different vendors and often don't speak to one another thus making	3	-1	1
29	PLF technology is not necessarily useful to small-scale farmers operating outdoor mixed housing system	0	3	-1
30	PLF technology often generates data that conflict with farmer expert opinions thus making PLF data less useful	-3	2	1

Appendix 5: Distinguishing and consensus statements

No.	Statements	Factor1	Factor2	Factor3
	Distinguishing statements			
1	PLF technology is a poor proxy of a farmer looking over the herd and detecting problems and addressing them		✓(4)	
4	PLF technology will improve pig health	✓(4)	✓(-4)	✓(0)
5	PLF technology will improve pig welfare		✓(-5)	
6	PLF technology will help in controlling disease outbreaks through traceability	✓(3)		
7	PLF technologies can lower the cost of pork production	✓(2)	✓(-3)	✓(-1)
8	PLF technologies are cost-prohibitive to use across the entire livestock system	✓(-1)		
10	PLF technology may digitize swine production and make it look less natural and more artificial		✓(3)	
11	PLF technology usage can lead to data privacy and data ownership conflicts			✓(4)
12	PLF technology can disconnect caretakers from pigs and make them less caring about pigs		✓(5)	
13	PLF technology will make it possible for consumers to verify welfare certification claims		✓(-3)	
14	PLF technology may discourage pork consumption because it is probably profitable on large farms which some		✓(2)	
16	PLF technology does not minimize the environmental impact of swine farming		✓(4)	
18	PLF technology usage is limited by poor internet connection on most swine farms			✓(5)
19	PLF technologies' data often cannot be used within existing management practices	✓(-5)	✓(0)	✓(4)
21	PLF technologies make the pig caretaker's job easier, safer, and better		✓(-1)	
22	PLF technologies are displacing labor and reducing job opportunities in the swine industry		✓(1)	
24	PLF technology should be a supplement to good management and not replace good management	✓(5)		
25	PLF technology is an environmentally friendly production system	✓(1)		
29	PLF technology is not necessarily useful to small-scale farmers operating outdoor mixed housing system		✓(3)	
30	PLF technology often generates data that conflict with farmer expert opinions thus making PLF data less useful	✓(-3)		
	Consensus statements			
3	PLF technologies can be used without any form of training	(-4)	(-4)	(-5)
9	PLF technology will increase swine producers' profit margin	(1)	(0)	(0)
17	PLF technologies are not as precise as technology development companies claim them to be	(0)	(0)	(2)
27	PLF technology will enable producers to accurately plan their feed conversion ratio (FCR) upfront	(0)	(-1)	(1)

Note that only statements whose Z-score value is statistically significant at 5%

✓ indicates that the statement distinguishes the factor

The value in parenthesis () is the Q-Sort value

Appendix 6a: Perspective 1: PLF improves management, animal welfare, and labor condition

Least like what I think					Neutral			More like what I think		
-5	-4	-3	-2	-1	0	1	2	3	4	5
19	3	1	2	8	14	9	7	5	4	24
	12	22	10	11	17	15	13	6	21	
		30	16	20	27	23	18	28		
				26	29	25				

Note: Numbers 1–30 are the numbers randomly assigned to the Q set statements in Appendix 1
The Factor Arrays values in Appendix 4 were used to sort the 30 random numbers into the grid

Appendix 6b: Perspective 2: PLF does not solve swine industry problems

Least like what I think					Neutral			More like what I think		
-5	-4	-3	-2	-1	0	1	2	3	4	5
5	3	7	6	21	9	2	14	20	1	12
	4	13	15	23	11	8	18	24	16	
		26	25	27	17	20	30	29		
				28	19	22				

Note: Numbers 1–30 are the numbers randomly assigned to the Q set statements in Appendix 1.
The Factor Arrays values in Appendix 4 were used to sort the 30 random numbers into the grid

Appendix 6c: Perspective 3: PLF has limitations and could lead to data own

Least like what I think					Neutral			More like what I think		
-5	-4	-3	-2	-1	0	1	2	3	4	5
3	1	16	10	6	2	24	5	8	11	18
	26	22	12	7	4	27	13	20	19	
		23	25	14	9	28	17	21		
				29	15	30				

Note: Numbers 1–30 are the numbers randomly assigned to the Q set statements in Appendix 1.
The Factor Arrays values in Appendix 4 were used to sort the 30 random numbers into the grid