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QFD for Membership Organizations — Practicing What We Teach

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Abstract

This paper reports an ongoing QFD initiative at the International Academy for Quality (IAQ), a membership organization founded in 1966 by Dr. Armand Feigenbaum along with European and Japanese quality experts. The IAQ's growing membership in developing nations means that member needs have to be periodically assessed and incorporated into future activities, beyond its original missions of facilitating an international exchange of quality expertise to promote quality throughout all nations. The paper will discuss the QFD process being used to reassess current member needs and plan future programs, including the data from member surveys, as well as the results to date and ongoing improvements to the organization.

Key Words: QFD, IAQ, Membership Organization, Voice of Customer

The International Academy for Quality (IAQ)

A Brief IAQ History

The role of quality thinking in transforming the post-war economies of Europe and Japan was recognized by Dr. Armand V. Feigenbaum, who played an early role in the 1960s in the American Society for Quality Control (now ASQ), European Organization for Quality Control (new EOQ), and the Union of Japanese Scientists and Engineers (JUSE). Dr. Feigenbaum was one of six individuals (two each from ASQ, EOQ, and JUSE) to meet in 1966 to structure the IAQ, which was officially organized in 1971. The original purpose of the IAQ was three-fold: to coordinate attention to technical problems in quality; assure the broad dissemination of the results of such work to the greatest benefit of those concerned; and promote recognition of the role and importance of quality in other disciplines as a concept and as a decisive factor in stimulating success in all disciplines.

IAQ Members familiar to the QFD community have included Kaoru Ishikawa, Shigeru Mizuno, Yoji Akao, Genichi Taguchi, Noriaki Kano, Tadashi Yoshizawa, Bob King, Greg Watson, and the author. Currently, there are 125 members of the IAQ.

IAQ Mission and Activities

The IAQ is an independent, self-supported, nonprofit, non-governmental organization that is administered by a collegial assembly of individuals who have been elected by their peers from among the most respected, active and experienced

proponents of quality in the world. The Mission of the IAQ is to fully utilize the leadership of the Academicians worldwide, individually and in teams, to advance worldwide, the knowledge, understanding and communication of the philosophy, theory and practice of all activities involved in achieving quality for the benefit of humanity.

Academicians make significant personal contributions to the advancement of quality and collaborate on team-based projects through participation in Think Tanks that operate within the Academy. Academician outreach has helped to establish many of the national and regional quality organizations and IAQ has supported the United Nations in its early efforts to bring quality to the developing world. Currently, IAQ is assisting national quality movements in Brazil, Russia, India, China and elsewhere as they develop mature programs that support quality development. Think Tanks concentrate IAQ member resources on applications of quality that require focus and coordinated support to advance knowledge and to leverage lessons learned in order to accelerate the development and adaptation of principles and methods to improve organizational performance for the benefit of society and to improve applications of core quality-related methods.

Think Tanks currently address the following social areas of application: governance, healthcare, and education. In addition IAQ Think Tanks also address: standards and compliance and applied statistics.

The QFD Project

In 2013, the IAQ Board of Directors asked me to assume the responsibilities of its secretary and treasurer. One of the objectives was to determine whether membership dues, its main source of operating income, could be raised in order to reflect its current operating costs. Dues had not been changed in recent years, and along with declining paying members due to deaths and elevation of academicians to honorary status. Employing a QFD perspective, I raised with the board that before increasing dues, it might be prudent to determine how satisfied members were with their current benefits. This would also be useful in attracting new members.

The QFD Process

As in many QFD projects, it is useful to define the objectives of the project in order to prevent scope drift (in a new direction) or creep (expanding beyond the original purpose. In this study, a Project Goals table documented these objectives. The next steps were to acquire, analyze, and prioritize the Voice of the Customer (VOC). Survey, Customer Voice table, Affinity and Hierarchy Diagrams, and the Analytic Hierarchy Process (AHP) were used. The results were used to emphasize both existing activities and to propose new ones.

Project Goals table

If the project is successful, what benefit will this bring to IAQ? Discussion among the directors focused on a few critical deliverables for the project. The main goal was to secure financial health by increasing dues and attracting new member nominations.

These are noted in the Project Goals Table 1, along with how we would measure if the goal was attained, our current and target performance, as well as a deadline and who will judge if the goal was achieved.

Table 1 Project Goals table for IAQ member project.

#	Goal Statement	How measured?	Current level	Target level	By when?	Who judges success?	Key?
PG1	Increase membeship dues	annual dues	ACN $200	ACN $300	FY2014	IAQ Board	■
PG2	Increase membership	# academicians (ACN) and	64 ACN and 22 AM	100 ACN and 30 AM	FY2015 (end of current triennial)	Chair - Nominations	□

Clarifying the project goals is an important step at the beginning of any project. It forces decision makers to clarify their expectations both among themselves as well as to those who will need to carry out the project. For the IAQ, this will guide out updating the current value proposition to reflect changing member needs in the future.

Customer Segments

IAQ members tend to be senior quality professionals who have spent their career pursuing statistical methods, improvement tools, quality management, and other aspects of quality. We place great value on sharing our knowledge with others who are sincere about joining the quality community and bringing the benefits of this thinking process to organizations and businesses in their country.

Since members in developed and developing economies may be at different stages in the quality maturity model, their priorities will differ. To better understand which members to whom we want to focus IAQ improvements, it is helpful to segment them. This is important when organizations have many customers, stakeholders, and clients and limited resources to apply to improving goods and services. At this time, the Academicians are the group we want to add the most, and so this segment was addressed first. It would also be noteworthy that IAQ members are committed to sharing quality knowledge with constituents within their local communities, so these constituents (educators, students, companies, government, etc.) could also be considered indirect customers.

Voice of Customer

Voice of customer is a key component of many improvement activities in modern organizations. It makes sense that listening to customers' wishes before design is more efficient and less costly than listening to their complaints afterwards. The voice of the customer can be acquired through survey questionnaires, interviews, customer visits, complaints, etc. In this case, an email survey was sent out to members with the following questions:

A. My IAQ Membership Status: Please select (Academician, Companion, Associate, Emeritus, Corresponding, Other)
B. I have been a member for ___ years.

C. Because of my membership in IAQ, I am able to _____.
D. I wish IAQ could help me _____.
E. I suggest IAQ do _____ because _____.

Questions A and B were demographic and helped me qualify if they were in the target segment. Question C was phrased to elicit what benefits members received rather than IAQ functions or features they liked. This is important for getting customer needs whose feature-independence will help us innovate new solutions. Question D was similarly phrased to elicit what benefits members wished for rather than a request for desired functions and features. This is important for getting members do described unmet opportunities they would like enabled. Question E was a direct request for suggested solutions and the reasons why they were desirable. This is useful for extrapolating unspoken customer needs by using a reverse-fishbone diagram that will extract desirable effects from suggested causes/solutions.

The survey received 20 responses from the 127 members, and included 12 academicians, 6 associates, 1 emeritus, and 1 honorary member representing North America, Europe, South Asia, Middle East, East Asia. Their responses were entered into the Member VOC Table 2. The table shows that some statements clearly reflect IAQ functions and capabilities such as "I am able to network with many leaders in quality," while other statements reflect true benefits such as I can "grow professionally." This is typical of open-ended survey questions and the next step will be to translate all statements into clear customer needs.

Table 2 Member VOC table (partial).

Region	Member type	Duration (years)	Likes about IAQ	Wishes IAQ do more	Suggestions
ME	Associate	2	support Quality movement in my region and worldwide	conducting studies, articles and technical support	
EU	Honorary	17	(1) the abiliy to network globally with peers; (2) opportunity to represent the quality movement globally at local confeences; (3) abilit to invite others to join and encourage recognition of their professional contributions.	work with the UN to develop national quality bodies throughout Africa	
Asia	Academician	5	join some quality related activities	join quality promotion activities held in Mainland China	organize an international annual conference that changes location every year
NA	Associate	2	Interact with a very distinguished peer group of quality practitioners; Collaborate on interesting Think Tanks	by assigning a dedicated Mentor to me as expressed in the Bylaws with research, publication, and presentation opportunities	Promote itself effectively within the Quality community as an innovator and thought leader in quality because: - ASQ targets the interests of the critical masses - IAQ can extend the limits and range of the profession to advanced or under-represented areas
	Emeritus	27	Because of my membership in IAQ, I am able to network with many leaders in quality and to grow professionally with my participation in international conferences where IAQ members had encouraged me to attend. I have very	I wish IAQ could help me continue with my participation in international conferences despite my age and I wish IAQ would make nominating to IAQ a faster process with less restrictions especially if the the candidate is a worthy one and is fully endorsed by other active Academicians.	I suggest IAQ do a review of their memberships' qualifications and their contributions either locally or internationally in the field of quality because I believe you are losing some very good members all because of a suspected "mafia" within IAQ.

Customer Needs

An important step in most improvement projects is to get meaningful results for the efforts made. This means having sufficient resources (time, people, money) to see the project through to completion. In modern times, resource constraints often limit what the quality team can address, and so prioritization is very useful. For customer driven projects, prioritization by customers is desirable.

Prioritization is most accurate when the evaluator has knowledge of the subject. Typically, customers will have more knowledge about their needs and benefits than they will about product features, functions, or solution concepts. It is common for customers to assume that certain features will deliver certain benefits, and sometimes these assumptions can be misplaced. In the above example, it is easy to assume that "networking with quality leaders" will lead to "professional growth." But it is conceivable that poorly organized meetings or emails with quality leaders does not lead to growth, and could even leave some members feeling left out. The "form" could be correct but the "spirit" missed. So, if a customer feels networking is important because they assume it leads to professional growth, they could be disappointed if it does not. By expressing VOC as customer needs statements, we can understand the desired benefits behind these assumptions and have customers can prioritize them directly.

Translation of VOC into customer needs uses two simple quality techniques – 5 whys and cause-and-effect diagrams. 5 whys asks to customer to state why they want a requested feature. For example, on a mobile telephone project, a customer VOC was "I want the phone to light up when it rings." This is clearly a product feature of "lighting up." So, we ask her why? "So I can find it quickly in my purse." Why? "So I can answer it quickly." Why? "So the caller does not think I am being rude or ignoring them by not answering." Why? "So the phone helps me improve relationships." This last statement is the true customer need – to improve my relationships.

Cause-and-effect diagrams can also be used effectively. In the mobile phone example, the product feature is requested in order to cause some desirable effect. We ask the customer, "If your phone illuminates when ringing, what benefit would you get?" "If my phone illuminates, I can find it quickly in a large purse," "…I can find it quickly at night," "…I can use it as a torch," etc. These statements are the true customer needs.

The IAQ member VOC were similarly translated into true customer needs using the Customer Voice Table 3. This table captures the 5-whys or the cause-and-effect analysis, with the causes (features, solutions) to the right in the "product" side of the chart and the effects (needs) to the left in the "customer" side. The customer needs are the output of this chart. So, if the VOC is a feature or solution, it is written on the right side and the corresponding needs entered into the left side. If the VOC is already a need, it is just entered into the left side. There is no need to add data to the "product" side at this time.

Table 3 Customer Voice table (partial).

Customer VOC				Product Analysis	Design	Other
member attributes	likes	wishes	needs	functional requirements	design requirements	suggestions
2 yr ME associate	support Quality movement in my region and worldwide	conducting studies, articles and technical support	I want to improve quality in my region.	Conduct research on quality topics.		
			I want to improve quality worldwide.	Publish articles on quality topics.		
			I want to share my best practice in quality.	Provide technical support on quality topics.		
			I want to share others' best practice in quality.			
			I want to improve my own knowledge and skills.			
17 yr EU Honorary	(1) the abiliy to network globally with peers; (2) opportunity to represent the quality movement globally at local confeences; (3) ability to invite others to join and encourage recognition of their professional contributions.	work with the UN to develop national quality bodies throughout Africa	I want to connect with respected quality experts worldwide.	speak at local conferences		Website has private and public areas. Give everyone a @iaq.org email forwarding address.
			I want to share my best practice in quality.	recognize contributions of quality professionals		
			I want to improve my own knowledge and skills.			
			I want to share others' best practice in quality.			
			I want the quality profession to remain strong.			
			I want to improve the image of quality movement worldwide.			
			I want to improve quality in emerging economies.		develop quality bodies in Africa	
5 yr ASIA ACN	join some quality related activities	join quality promotion activities held in Mainland China	I want to connect with respected quality experts worldwide.	organize quality activities	China	organize an international annual conference that changes location every year
			I want to share my best practice in quality.	organize annual conference in different locations		
			I want to improve quality in my region.			
			I want to improve my own knowledge and skills.			

Structuring Customer Needs

When prioritizing needs, customers will find it easier to work in clusters of needs then with the full list at one time. Clustering the needs should be a subjective task that captures the participants' perspectives. The Affinity diagram is a very useful tool for this clustering process because its bottom-up approach requires subjective thinking. IAQ participants were sent a list of the 17 customer needs, with duplicates removed. While there were some minor differences among the clusters, they were easily combined into a master Affinity diagram shown in Figure 1.

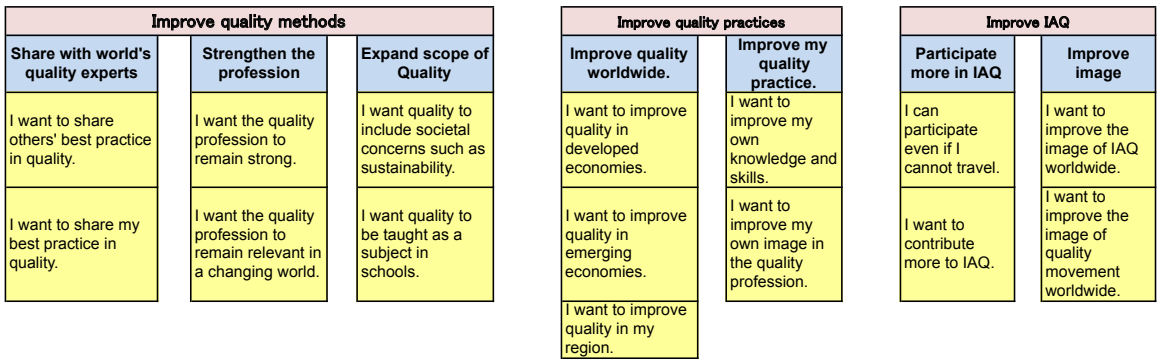

Figure 1 Affinity diagram of member needs.

The subjective Affinity diagram can also be reviewed with the more objective Hierarchy diagram. The purpose of the review is twofold: first to check for level of

abstraction errors, and second to check for missing, unspoken customer needs. These are necessary for the prioritization process where customers are asked to judge the importance of the needs. If levels of abstraction are incorrect, accuracy of the judgments is decreased. For example, if asked if one prefers an apple or an orange, a respondent can quickly choose. However, if asked if one prefers an apple or a piece of fruit, the respondent is confused since an apple is a subset of fruit. In other words, apple and fruit are on different levels of abstraction, and an accurate judgment cannot be made.

The second review is to check for missing customer needs. For example, a restaurant menu is typically divided into clusters (primary) such as starters, main dishes, and desserts. Moving to the next detailed level of abstraction (secondary) for starters, the menu is divided into soups and salads. Moving to the next detailed level of abstraction (tertiary) for soups, the menu shows onion soup, vegetable soup, and chicken soup. Within this set of soups, it is easy to identify missing members such as tomato soup, bean soup, etc.

The hierarchy diagram in this case study passed the reviews without change, and will be shown later in the paper after the prioritizations have been added.

Prioritizing Customer Needs

The next step is focusing improvement and development effort on what is most critical to customers. This is useful if the organization, like the IAQ, has limited resources to carry out its activities. As a membership organization, the IAQ has no paid staff itself and relies on volunteer action by its members, many of whom are busy with their regular jobs and responsibilities. Thus, it is both reasonable and respectful to prioritize activities and begin with those that matter most to the members.

There are many prioritization methods in use, but as a statistical method, QFD has relied on the Analytic Hierarchy Process (AHP) since it was first applied in QFD by Dr. Yoji Akao and one of his graduate students, Satoshi Nakui in 1987.[1] AHP creates ratio scale priorities that can be further manipulated in the QFD process. Knowing the mathematical limitations of different scales is important to maintaining accuracy of the analysis.

There are four common numerical scales used in judgment and decision-making – nominal, ordinal, interval, and ratio.

- Nominal scales are where numbers replace a name (such as on athlete's jerseys) and it would be inaccurate to assume player #10 was better than #5 just because the number was double. Nominal scales do not support +, -, X, / mathematical functions.
- Ordinal scales give order but the interval between the scale levels are indeterminate. In the Olympics, we know the Gold Medal is better than

the Silver Medal, but the medal color does not tell us how much better. We don't know if the Gold won by 0.01 seconds, 1 meter, or 1 kg, Ordinal scales also do not support +, -, x, / mathematical functions. Rating scales, such as the commonly used Likert-type (1-5 or 1-10) are also ordinal and are often misused despite these limitations. In customer satisfaction surveys, for example, when respondents score an 8 for "I was greeted with a smile" and a 4 for "I was seated quickly," is the former truly twice as good as the latter? Actually, we don't know because the undefined intervals of the ordinal scale do not contain sufficient information to tell us that. Additional problems arise when some respondents tend to cluster their scores toward the bottom 1-5 range (pessimists!), the center 4-8 range (can't make up their minds!), or the top 7-10 range (optimists!). This means that traditional calculations such as mean (which requires addition and division), standard deviation (which additionally requires raising to powers), should not be done with ordinal scale numbers.

- Interval scales have defined intervals but are “local” to the scale. For example, $10^{o}C$ is twice as high as $5^{o}C$ and $10^{o}F$ is twice as high as $5^{o}F$, but $10^{o}C$ is not twice as high as $5^{o}F$ because they are on different scales. So, a formula must be used to translate one scale to another, and it retains the accuracy of the values because the intervals are defined. However, we cannot say that $10^{o}C$ has twice the heat as $5^{o}C$ because it would not accommodate negative temperatures. If $10^{o}C$ had twice the heat as $5^{o}C$, what would the ratio be for $10^{o}C$ to $-5^{o}C$? For this type of problem, we use the Kelvin scale, which is an absolute ratio scale.
- Absolute ratio scales have a real or theoretical zero point and all numbers on the scale have defined and equal intervals. This scale supports all the +, -, X, / mathematical functions as well as mean, standard deviation, etc. and is the preferred scale for decision making since the outcomes are often used to allocate time, people, and money where accuracy counts.

In subjective decision-making both by customers and project teams, however, it is very difficult to get people to accurately assign ratio scale numerical evaluations. People are much better at using natural language and when limited to comparing two things at a time. It has also been shown that human judgment does best when there are 7 ± 2 levels (5 or 9) from among which to choose.[2]

The Analytic Hierarchy Process (AHP) was created by Dr. Thomas Saaty [3] in the 1960s to facilitate decision making using natural language inputs and ratio scale numerical outputs. The natural language scales and decision matrix math were proven with numerous examples where the results were known a priori. AHP has added features of calculating judgment inconsistency (a>b, b>c, but c>a) and can does not require group consensus to a single score. The benefit of this approach are a faster, more natural way to make decisions, accurate numerical priorities, a trap

for those trying to push an agenda, and a way to make progress even when there is disagreement. For quality professionals, this method can be applied where inaccurate ordinal scale scoring is currently used such as in project selection, customer satisfaction surveys, technology concept selection, make/buy decisions, supplier evaluations, FMEA RPN calculation, equipment or software package selection, hiring decisions and student evaluations, and even personal decisions such as which car to buy, which university for our children to attend, which healthcare option is best, etc.

The AHP was applied to the IAQ customer needs by sending web surveys to participating members in three rounds, corresponding to the three levels of abstraction in the Affinity and Hierarchy Diagrams. The process helped reduce the required number of judgments by beginning at the most abstract level and then prioritizing only the most important branches beneath them. The averaged results from the three primary level needs are shown in Figure 2.

Primary	Improve quality methods	Improve quality practices	Improve IAQ	*normalized columns*			sum	row avg
Improve quality methods	1	**1 4/5**	**1 1/4**	0.425	0.392	0.446	1.262	**0.421**
Improve quality practices	5/9	1	**5/9**	0.235	0.217	0.197	0.649	**0.216**
Improve IAQ	4/5	1 4/5	1	0.340	0.392	0.357	1.088	**0.363**
	2.353	4.615	2.803	1.000	1.000	1.000	3.000	1.000
						Inconsistency Ratio		**0.00**

Figure 2 AHP for primary level member needs.

The paired comparison values in the left side of the grid show the geometrically average results of all respondents. The inconsistency ratio is 0.00, which is far below the problem threshold of 0.10. A web survey was then made for the secondary level branches of "Improve quality methods" and "Improve IAQ" which received the two highest priorities. The final AHP tallies (with some rounding differences between the web survey and Excel) are shown in the prioritized Hierarchy diagram in Figure 3. The two highest priority tertiary needs were "I want quality to include societal concerns such as sustainability" and "I want to improve the image of quality movement worldwide," which combined added to nearly 22% of all importance for the 17 member needs.

Developing Solutions

The hierarchy and priorities were presented to the IAQ membership at the General Meeting in May 2013, preceding the ASQ World Conference on Quality Improvement in Indianapolis IN, USA. An engaging discussion to brainstorm ideas was very effective because there were only two issues to focus on. Some of the most promising ideas are under way or are being considered are shown in Table 4.

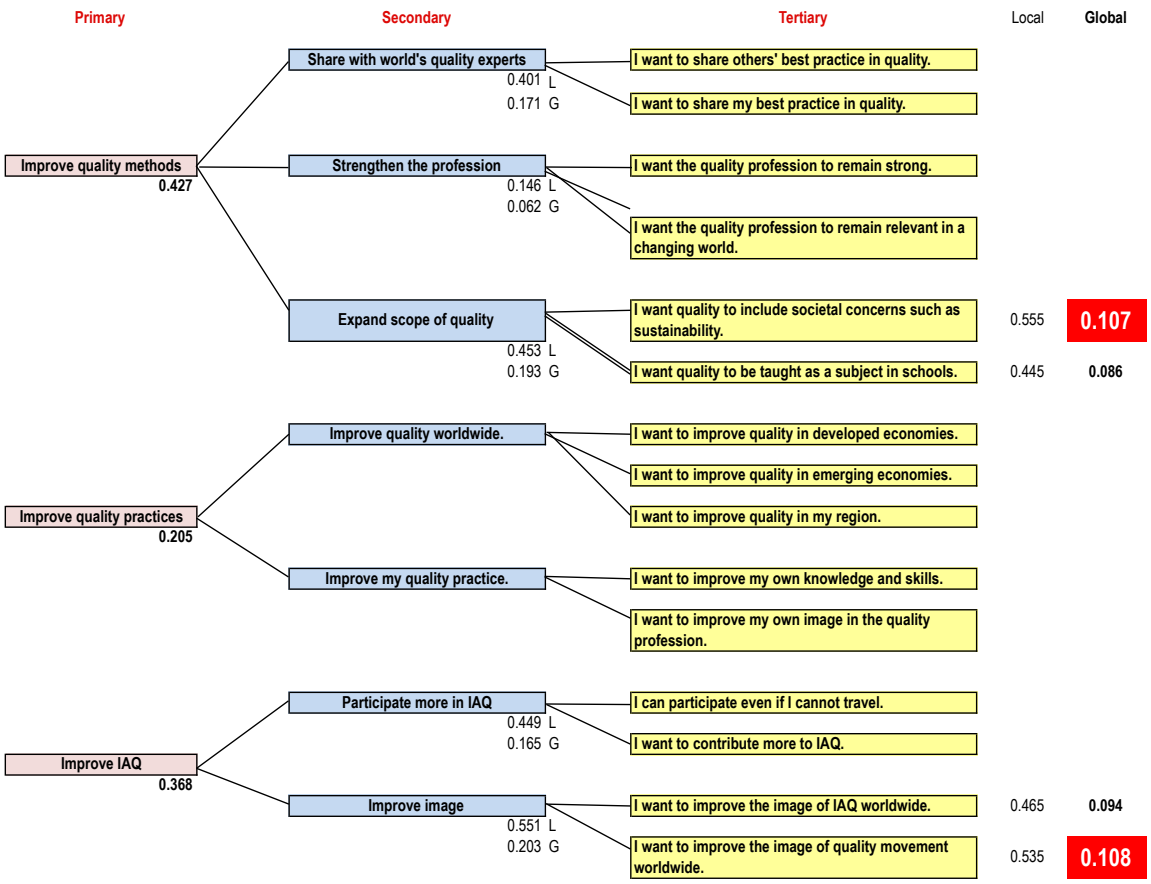

Figure 3 Prioritized hierarchy diagram of member needs.

Table 4 Proposed activities to address key member needs.

I want quality to include societal concerns such as sustainability.	**I want to improve the image of quality movement worldwide.**
Member papers on concerns in their regions.	Members create short videos on their expertise.
Connect with UN interest areas. (UN Decade of Quality initiated by Acn. Teitelbaum)	Develop joint industry/university research as in Japan.
IAQ Think Tanks focus on societal areas like education. (already underway by Acn. Janke)	Re-release IAQ's seminal Best on Quality series. (copyright secured from ASQ by Acn. Mazur)
IAQ Think Tanks share relevant articles from members.	Focus on senior management to show why quality makes a difference to their company, using case studies and success stories.
	ASQ Webinars by IAQ members. (QFD begun by Acn. Mazur)
	Improve IAQ website for easier access. (Acn. Mehta has launched www.iaqweb.org)
	Improve ISO relationships. (liaisons with TC69 and TC176 reinstated by Acn. Mazur)
	Create more awards for academic research in quality.

Next Steps
Current IAQ president, Janak Mehta, is encouraging the IAQ to improve its performance by implementing some of these suggestions. As shown in Table 4, some of these initiatives have been underway and as members commit, more will happen.

Conclusion
Membership organizations must learn to harness the volunteer resources of their members by focusing on a few needs and seeing them through to completion. If there are too many initiatives, money and time get diluted to the point of ineffectiveness and less service to their constituents and clients. QFD has been shown to be an effective and quick approach (the first survey went out March 28 2013 and the final results were tabulated on April 29 2013, for presentation at the IAQ General Meeting on May 4 2013) for understanding and prioritizing member needs and facilitating their involvement in developing solutions that work.

About the author
Glenn H. Mazur has been active in QFD since its inception in North America, and has worked extensively with the founders of QFD. He is the Conference Chair for the annual North American Symposium on QFD. Glenn is the Executive Director of the QFD Institute and International Council for QFD, retired Adjunct Lecturer on TQM at the University of Michigan College of Engineering, President of Japan Business Consultants Ltd., and is a senior member of the American Society for Quality and the Japanese Society for Quality Control. He is a certified QFD Red Belt® (highest level), one of two in North America. He is a certified QFD-Architekt by QFD Institut Deutschland and Honorary President of the Hong Kong QFD Association. He is convenor of the ISO Working Group 2 of the Technical Committee 69, Subcommittee 8 to write the international standard for QFD and a member of Technical Committed 176, Subcommittee 3 on quality management. He is an academician of the International Academy for Quality.

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