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The Delphi technique: A credible research methodology

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Abstract— The Delphi technique, as a research method for achieving consensus of opinion of participants, is sometimes seen as a less reliable research method because the participants do change their opinion from one round of the exercise to the other. Instead of seeing this as weakness, it is actually the strength of the technique. The controlled feedbacks allow participants to view their individual submissions in the light of the whole group. The Delphi technique is about the only research method that allows participants to interact with the opinion of each other, without coercion, adjust ones position where necessary and yet retain anonymity. Thoughtful selection of participants and effective communication throughout the exercise ensures that the outcome of the exercise is truly a consensus opinion of the group that can proffer appropriate solution to the research question. The participants for the Delphi exercise, being reported, were chosen from the strategic and tactical levels of leadership of the client, end-user and the service provider. Though participants changed their opinion from one round to the other; the net result showed a more refined selection of appropriate Key Performance Indicator, without evidence of complicity or coercion.

Keywords— Delphi technique, Participants' opinion, Selection of participants, Effective communication

I. INTRODUCTION

The Delphi technique may not fit perfectly into the classical divide between qualitative and quantitative research methodologies or as a tool for mixed methodology but a 'hybrid' of qualitative and quantitative research method. It is a single technique that integrates the elements of both qualitative and quantitative methodologies in addressing specific research problem. Critics have sort different ways to discredit the Delphi technique as a valid method of robust research. One of the subtle criticisms is that panel members 'may change their views in line with perceived superior opinions', especially when the participating panelist know about other participants whom they hold in high esteem [1, 2]. When participants change their opinion from one round of the Delphi exercise to another should not be seen as weakness but strength of the Delphi technique; especially when these changes are unique to the individual participants. The controlled feedbacks allow participants to view their individual submissions in the light of the whole group, "bringing panelists towards group consensus" [1]. The choice and use of the Delphi technique for consensus building stem from the concept or theory that "several people are less likely to arrive at a wrong decision than a single individual" [1 p. 1013]. A unique features of the Delphi method is that decisions are reached through informed consensus of knowledgeable participants [10]. Two internal components of a typical Delphi exercise that helps to guide against 'bandwagon' effect are the choice of the panel of experts and effective communication between research facilitator and participants.

Athough the term 'experts' have attracted some debates, for simplicity sake, the term 'participants' will be used in this paper. The participants are individuals within an elastic continuum of inclusive population of individuals with broad based professional and experiential knowledge of the subject and willing to dedicate time to the repeated process of the Delphi exercise [3]. The participants are not chosen at random but 'purposively' adopting defined prequalification criteria [14, 10, 4, 5, 6]. Therefore, participants chosen from within these envelops should be persons of integrity with independent mind, whose opinions can be trusted. Reference [1] observes that "if individuals are to be affected directly by the decision to be made, they are more likely to become involved in the Delphi process".

The research being reported in this paper is part of a larger research exercise designed for the mutual development of Key Performance Indicators (KPIs) for measuring the performance of the operation of the Facilities Management (FM) unit in a

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Higher Education (HE) institution in South Africa. The panel members were drawn from the strategic and tactical levels of leadership among the client –Dean of faculties, costumer or end-users –Heads of academic departments and the service providers -Facilities Management (FM) unit. The structure of this paper commences with literature review, the research method, findings and discussion and culminates with conclusion and recommendation.

II Literature review

Literature review serves the purposes of helping the researcher to position the new work in the context of previous research efforts by identifying existing theories and models; it helps new research efforts to identify unresolved problems in the field being studied and allows the new research effort to benefit from tested methods. In the area of consensus building, the Delphi technique is an emerging methodology gaining wide acceptance in both academic and industrial related research. The literature reviewed here provides general information on the use of the Delphi technique and how to mitigate potential shortcomings.

A. The Delphi technique

The idea of obtaining solution to strategic or operational problem through 'group' decision or 'consensus' building process is a well-established management approach. Some of the common tools used to achieve this objective include the Value Engineering (VE) seminar [7, 8], Focus Group (FG) session [9] and the Delphi method [10, 11]. The major difference between the VE and FG on the one hand and Delphi technique is that, in the former the participants congregate at a point and share ideas on the subject under reference, with the disadvantage of the most influential figure in the group lording it over the others. While in the Delphi technique the participants act as autonomous individuals contributing to, the "consensus opinion of a group of experts by a series of intensive questionnaires interspersed with controlled feedbacks" [5]. There are up to ten different types of Delphi design [5, p. 1697] but three common classifications of the Delphi techniques in practice and the variations within each classification include, classical, decision-making and policy Delphi [12]. A brief description of the three types follows:

> The classical Delphi method functions as a forum for establishing facts about a specific situation or topic. The decision-making Delphi is used to encourage collaborative decision making. Idea generation about a topic is the purpose of the policy Delphi [12, p. 238].

The Delphi technique is useful where information gathering and feedback from stakeholders (experts) are difficult due to busy schedule (academics), geographical barriers and the need to guarantee anonymity [11].The tool is "useful when objective data are unattainable, there is a lack of empirical evidence, experimental research is unrealistic or unethical, or when the heterogeneity of the participants must be preserved to assure validity of the results" [4, p. 1]; or the "issue under investigation does not lend itself to precise analytical techniques, but can benefit greatly from subjective judgments on a collective basis" [10, p. 114]. The Delphi technique for consensus building hinges on the concept that "several people are less likely to arrive at a wrong decision than a single individual" [1, p. 1013]. One of the unique features of the Delphi technique is that decisions are reached through informed consensus rather than through the opinions of many uninformed participants [10].

B. The Delphi panel

The basic principles underpinning the Delphi technique include the identification and use of cognate participants (who may or may not know each other) capable of addressing the issues raised in the research question [12]; the contribution of each member of the panel is treated in confidence and no participant will be traceable to its contribution [13]; the group interacts with the issue at stake through a series of iteration of processes, where the information on previous iterations is communicated to all participants to see; all submissions are processed through a central coordinator or facilitator, who recycles the feedback to participants after each iteration [13,12]. The size of a Delphi panel may be as small as three members and as large as 80 [2, 10]. It is important to select people who are knowledgeable in the field of study and they are willing to commit themselves to multiple rounds of questions or interactions on the same topic [10].

Adopting appropriate prequalification criteria for the selection of participants allows the coordinator to harness individuals with substantive knowledge in the area being investigated, commonly known as 'panel of informed individuals'

[2, 14, 6]. The selection exercise could be as simple as possible or complex, but the objective is to identify experts in the field of study and by extension the quality of the result. Grisham [10] did a cross-cultural study that was to test the hypotheses that "there are universal attributes for cross-cultural leadership that are effective regardless of culture" [10, p. 119]. To examine this topic, he raised a panel of 25 experts from different regions of the world to include: Eastern Europe, Nordic Europe, Germanic Europe, Latin Europe, Latin America, Confucian Asia, Southern Asia, Anglo, Sub-Saharan Africa, and the Middle East" [10, p. 122]. The author described his group of experts "as a person that has at least 20 years of practical experience working in an international or multicultural environment, in any industry or a person that has an advanced degree in leadership or cross-cultural studies with over 20 years of research, teaching, publication experience; or a combination of the two" [10, p. 121].   The method of selecting the participants follows closely to the 'purposive or criterion sampling' rather than random sampling [1], because the participants are selected for a purpose, to apply their knowledge or expertise to a certain problem situated within the confine of the area to be investigated. Concerted efforts should be made to manage the effects of high attrition rates by recruiting large number of participants at the initial phase, exceeding the set mark for 'preferred group size'. The best approach to secure effective participation is to engage prospective participants on a one-on-one interaction, where possible [14, 3]. Using the data base of professional bodies, institutions, etc. are possibilities but may not be reliable due to changes in the location of the individuals.

C. Managing the Delphi process

The Delphi exercise can be administered using either or both the Paper and Pencil (PP) Delphi or Real Time (RT) Delphi; using the computer system [11, 6]. Reference [11] confirmed that the results obtained from both methods to address the same problem were identical. The procedure is to circulate the information the participants are to interact with, collate the response and re-circulate the feedback to the panel members. The process continues until consensus is achieved. There are no firm rules regarding the number of rounds in the Delphi exercise, one or many rounds of information gathering suffices, so far the facilitator is satisfied with the level of consensus, convergence of opinion or the participants are no longer modifying their earlier decisions [12, 16]. However, there are information in literature suggesting consensus range of between 51 & 80% of agreement amongst participants [1]. The method of determining convergence of opinion should be spelt out at the beginning of the exercise [17, 14], applied and communicated to all participants through the different rounds and in the final report. The use of descriptive and inferential statistics are standard ways of ascertaining the level of collective opinion; computing and disseminating information on central tendencies (means, medians, and mode) and levels of dispersion (standard deviation and the inter-quartile range) to participants allows them to see the trend about the collected opinion [1,14,16].

III.   RESEARCH METHOD

The subject of this research was the development of performance measuring standard with which to measure the performance of the Facilities Management (FM) unit of a Higher Education (HE) institution in South Africa. This was a single unit case study [17] that requires "an intensive study for the purpose of understanding a larger class of (similar) units" [18, p. 342]. Although there are no strict rules on the sample size in qualitative research, however, using the Delphi technique for data collection, the sample size of eight participants is an acceptable minimum [4]. In order to manage the attrition rate, a large sample size was recruited at the initial stage from the target population who are knowledgeable in the subject of the research and willing to participate in the exercise.

IV FINDINGS AND DISCUSSIONS

The 'modified classic' Delphi type [5] was adopted in this research. It involved the circulation of a generic list containing 112 industry-wide KPIs, gleaned from literature and experience, arranged around seven main headings and eight sub-headings. Participants interacted with the document, rating each item, anonymously, according to their perception of the order of importance, using the Linker scale of 1-5, where 5 is the highest and 1 the lowest rating. The exercise went through three rounds of collating and successive iteration before results were escalated to the next stage. The participants were informed about the rules of the game as follows:

> The items on the list are not in any particular order. Please, interact with the list and rate each item in your considered order of importance on a scale of 1-5, with 5 being the highest and 1, the lowest rating. Mail your

response to me for collation. We will engage with this process, at least, three times. Only the items that are rated 3 and above, in this first stage, will be escalated from first to second stage. Similarly, the items that are rated 3 and above in the second stage will translate to the third stage and the items rated 3 and above in the third stage will constitute the performance standards – Key Performance Indicators (KPI), to be arranged in their order of priority and classification in each sub-section. I will circulate the final result to all participants at the end of the exercise, after a focus group discussion.

Their responses to the information on the section dealing with 'safety issues', is cited here to illustrate the Delphi process. A generic list of ten items was circulated to participants in the first round. Although the list of items did not reduce from one round to the other, but the position of the items kept changing, reflecting the priority perception of participants [14, 3, 15]. Table 1 shows the response to the three rounds.

Table 1 Response to the Delphi process on safety issues

	SAFETY ISSUES					
S/No	Round 1	Score	Round 2	Score	Round 3	Score
1	Compliance to statutory regulations	4.2	Effective management and disposal of hazardous materials	4.44	Effective demarcation of unsafe areas	4.57
2	Effective demarcation of unsafe areas	3.93	Compliance to statutory regulations	4.67	Compliance to statutory regulations	4.57
3	Maintaining safe working environment within academic facilities	4.13	Maintaining safe working environment within academic facilities	4,57	Maintaining safe working environment within academic facilities	4.57
4	Training of safety personnel in every local unit for teaching and research facilities	3.8	Effective communication before evacuation drill	4.22	Effective management and disposal of hazardous materials	4.71
5	Periodic education on safety matters	3.33	Effective demarcation of unsafe areas	4.78	Training of safety personnel in every local unit for teaching and research facilities	4.21
6	Proper signage	3.8	Regular practice of evacuation drill	4.22	Regular practice of evacuation drill	4.0
7	Regular practice of evacuation drill	3.87	Training of safety personnel in every local unit for teaching and research facilities	4.33	Effective communication before evacuation drill	4.0
8	Effective management and disposal of hazardous materials	4.33	Periodic education on safety matters	3.89	Proper signage	4.21
9	Effective communication before evacuation drill	4.07	Proper signage	4.11	Periodic education on safety matters	4.07
10	Installation of cable network in accordance with relevant building code.	3.27	Installation of cable network in accordance with relevant building code.	3.89	Installation of cable network in accordance with relevant building code.	3.64

Furthermore, in round 3, participants were encouraged to rate the items according to their perceived order of priorities. A synthesis of the final response identifying the priority list and classification of the KPIs is shown in table 2. The items classified under high and medium priority agrees with the strategic objectives of the institution. This challenges the service

providers (FM) unit to pay priority attention to these items to ensure safety within the built facilities of the university in the interest of the staff, students and visitors. Research on safety within built facilities have stressed the need for consistent information flow, maintain functional egress route, main and emergency exit facilities in order to reduce fatality rates [19, 20]; adequate and legible signs to guide end-users to the nearest exit; adopt consistent color to indicate the directional signs and exit features [19, 20].

Table 2 Priority list of KPIs and classification

S/No	Category	Description, classification and rating		
		High priority (4.5-5.0)	**Medium priority (4.0-4.49)**	**Low priority (3.5-3.99)**
		Safety issues		
		Effective management and disposal of hazardous materials	Training of safety personnel in every local unit for teaching and research facilities	Installation of cable network in accordance with relevant building code.
		Compliance to statutory regulations	Proper signage	
		Maintaining safe working environment within academic facilities	Periodic education on safety matters	
		Effective demarcation of unsafe areas	Effective communication before evacuation drill	
			Regular practice of evacuation drill	

V CONCLUSION

The Delphi technique, as a research method, seeks to achieve 'consensus opinion of a group of experts' through repeated exercise where the participants have the liberty to change their opinion without coercion through the effective management of controlled feedbacks from the research coordinator [14, 5]. When participants change their opinion should be seen as strength and not weakness, because it is only the Delphi technique that allows participants to see the contribution of other participants in the same research exercise. The controlled feedbacks allow participants to view their individual submissions in the light of the whole group, "bringing panelists towards group consensus" [5]. Furthermore, the integrity of a Delphi exercise increases by paying due diligence to the selection of participants who should be experts in the field of study, including those to benefit from the result in the exercise, stating the rules of engagement, method of achieving consensus of opinion and effective communication throughout the process [14,5].

During data analysis, the coordinator should have eyes for details [14, 11, 5]. Through the unique coding system, it is possible to monitor the opinions from participants who knows each other; thus challenging the coordinator to act decisively to ameliorate the negative impacts of complicity on the credibility of the exercise. In the exercise reported in this paper, though there are evidences of the participants changing their opinions from one round of the Delphi exercise to another, the changes only helped to reorganize the KPIs in their order of priorities. The final conclusion is that the Delphi technique is a suitable research method for addressing complex issues within the Engineering and built environment industry, without fear of complicity or coercion, even when the participant know each other. This level of certainty can be achieve through the painstaking selection of appropriate participants, the skill of the research coordinator and transparent communication between the rounds and in the final report.

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