

The Fuzzy DEMATEL based Job Accommodation Strategy Definitions for Operators with Hearing Impairments

Chi-Yo Huang
Dept. of Industrial Education
Nat. Taiwan Normal
University, No. 162, Ho-Ping
East Road I, Taipei, Taiwan
cyhuang66@ntnu.edu.tw

Gwo-Hshiung Tzeng
Inst. of Project Management
Kainan University
No. 1, Kainan Road,
Luchu, Taiwan
ghtzeng@mail.knu.edu.tw

Abstract — The job accommodation, the redesign of a job or the creation of new vacancies for optimizing the utilization of manpower through job analysis, has become an important concept during the past decades. Effective job accommodation strategies can assist the people with disabilities in general, and hearing impaired people, who accounted for a majority of the disabilities in the labor market, in special, to expand their capability set and maximize their work performance. However, very few researches have been developed on how the job accommodation strategies can be defined. Furthermore, most available job accommodation strategies as well as assistive technologies were based on researches being developed one decade ago, which are not feasible and should be updated for modern industries. Thus, a fuzzy DEMATEL based MCDM framework will be introduced for deriving suitable accommodation strategies. An empirical study based on the operators from the electronic industry advanced and verified both available job accommodation strategies as well as job accommodation research methods. In the future, the proposed strategies as well as the research framework can be used to enhance the welfare of the disabilities.

Keywords – Job accommodation strategy; Fuzzy DEMATEL; Fuzzy MCDM (Multiple Criteria Decision Making, MCDM).

I. INTRODUCTION

People with disabilities work in a variety of environments including management, administration, technology, design, and industry settings [1]. The potential for and importance of job accommodations, the redesign of a job or the creation of new vacancies for optimizing the utilization of manpower through job analysis, for qualified individuals with disabilities is clear in light of developments in human rights, technological innovations, and changing perceptions of the environmental barriers and facilitators for inclusion in work and in society at large [2]. Effective workplace accommodations are essential for the economic independence and self-determination of people with disabilities, and to maintain a productive workforce [2]. However, a large portion of adults with disabilities had no jobs though these people are willing to work. Recent studies reveal a paucity of workplace accommodations to compensate for loss of hearing [3]. Thus, researches on how job accommodation strategies and use of assistive technology resources and services can be defined can help to level the playing field for persons with disabilities so that they can compete on an equal basis in finding and maintaining employment [4].

Severity of a disability impacts an individual's ability to work [1]. People with physical and sensory limitations are more likely to have lost work days than the general population [1]. As summarized by Zolna et al. [5], reviews and reports of general accommodation strategies, specific interventions, vocational rehabilitation methods, etc. have all addressed the use of specialized designs and assistive technologies (AT) as workplace accommodations for people with disabilities. However, some accommodations have been successful, whereas others have not [5].

The existing knowledge base of accommodations contains a wealth of information about the needs, functional abilities, and criteria for successful intervention. While aggregated, these data can be crucial in informing [5]. Employers and persons with disabilities are likely to enjoy successful employment outcomes through increased knowledge and information sharing [2]. Proactive policies that allow for matching between employees' needs and job skills and available resources may help to bridge the gap between current and state of the art accommodations [2].

The total, civilian, non-institutionalized hearing-impaired population is estimated at 9.4% while the world population percentage is expected to be similar [6]. Further, recent statistics demonstrate that the people with hearing impairments has accounted for about 40% of the labor market. Apparently, employees with hearing impairments can be classified as one of the major groups of employees with disabilities to be focused. Further, in some electronic industries of the developed East Asian countries like Taiwan, the hearing impaired operators have already accounted for a significant percentage to the total employees with disabilities. Job accommodation strategy definitions for the hearing impaired operators are worth further study.

Albeit important, very limited study has empirically evaluated the importance of on-the-job accommodations for persons who are hard of hearing while accommodation practices were found to be a significant factor in employment success for persons who were deaf [7]. Allaire et al. also mentioned that relatively little is known about the kinds of work barriers experienced by employed persons with arthritis and other rheumatic diseases and to what extent these individuals utilize job accommodations. Further, the job accommodation is by nature an MCDM problem. According to the job accommodation procedure being proposed by Schneider [8], the major steps include determine alternatives and outline strategies for modifying the specific job task in question, review the alternatives/strategies with the employer and finally, agree on the appropriate modification or

adaptation. The availability of accommodations, therefore, is likely to be related to attributes of employees and employers but limited attention has been paid to identifying covariates of either the availability of, or the need for, accommodations for people who are deaf or hard-of-hearing [3].

Therefore, this research intends to define a fuzzy DEMATEL based multiple criteria decision making (MCDM) based framework for selecting defining job accommodation strategies for operators with hearing impairments. At first, literature regarding to job accommodation strategies for disabilities and the selection criteria will be reviewed. The literature will serve as a basis for the MCDM framework development as well as possible alternative derivations for suitable job accommodation strategies. Then, the fuzzy DEMATEL will be used for constructing the structure of the decision problem. The weights being versus the criteria will be derived by using the ANP then. Finally, the GRA will be used for deriving the relationships between the possible job accommodation strategies as well as the criteria. The job accommodation strategies with the highest Grey grades will be selected as the suitable ones.

This research is organized as follows. The related literature regarding to capability set expansions and the job accommodation strategies will be reviewed in Section II. The theory which is based on MCDM framework and using the fuzzy DEMATEL based MCDM method will be introduced in Section III. An empirical study on expanding the capabilities of hearing impaired people will be used for demonstrating the feasibility of the proposed fuzzy MCDM framework in Section IV. Implications as well as discussion will be presented in Section V. Finally, the whole article will be concluded in Section VI.

II. CAPABILITY SET EXPANSIONS AND ACCOMMODATION STRATEGIES

An adoption of the accommodation strategies for the people with disabilities is a typical example for capability set expansion problem. By introducing the accommodation strategies, persons with disabilities can be assisted to expand their capability set and then level the playing field for persons with disabilities so that they can compete on an equal basis in finding and maintaining employment [4]. Following, past researches and concepts regarding to the capability, the capability set, people with disabilities as well as accommodation strategies with a focus on accommodation strategies for people with hearing impairments will be reviewed as a basis for the decision making framework.

Capability is an integration of knowledge, skills, personal qualities and understanding used appropriately and effectively - not just in familiar and highly focused specialist contexts but in response to new and changing circumstances while competence is primarily about the ability to perform effectively, concerned largely with the here and now [9]. Stephenson argued that narrowly defined competencies were only part of human capability [10]. Fraser and Greenhalgh [11] mentioned that capability is more than competence since competence is what individuals know or are able to do in terms of knowledge, skills, attitude while the capability is the extent to which individuals can adapt to change, generate new knowledge, and continue to improve their performance. Doncaster and Lester [12] further argued that capability is not restricted to being "almost synonymous with competence, but with less of a normative connotation" [13], but also implies a capacity to develop additional competence and to move beyond competence to being able to work effectively in unpredictable and changing contexts [12].

According to Yu [14-16], for each decision problem (e.g. job selection, corporate strategic definition, conflict resolution, etc.), a competence set consisting of ideas, knowledge, information and skills for its satisfactory solution exists. However, since competencies were only part of human capability, the concept of the competence set can further be expanded to the capability set. According to the definition by Srinivasan [17], the capability set is the set of vectors of functions the states of being and doings such as being healthy and avoiding premature mortality, available to a person.

People with disabilities work in a variety of environments and accommodations in these environments enable them to enter and remain in the workplace while the rate of employment is dependent on the educational level of the person as well as the physical and cognitive capacities of the person [1]. However, workplace environments are not optimally suited for people with disabilities even when people with disabilities are more likely to remain employed if their employer provides necessary accommodations [1].

Workplace accommodations, by their very nature, are solutions that are either individualized for specific employees or for groups of employees (e.g., wheelchair users or aging workers) [5]. The most frequently mentioned direct benefits from implementing workplace accommodations were retained a qualified employee, increased worker productivity, eliminated the cost of training a new employee, etc. [18]. As a result, specialized accommodations, such as those for people with mobility and dexterity impairments are not typically considered to be usable by all people, to the greatest extent possible [5].

According to the summarization in the work by Zolna et al. [5], the most commonly seen barriers to work include functional limitations due to the design of furnishings and workstations, computer-related difficulties, macro environmental barriers included transportation problems (e.g. parking and commuting) as well as access to specific spaces required for activities of daily living (e.g. bathrooms), functional limitations including fatigue, pain, physical weakness, inability to stand for long periods, changes in physical sensation which become barriers to work. Scherich [19] further identified the six difficult workplace situations being identified by workers with hearing impairments: receiving instructions/supervision, department/staff meetings, in-service or training activities, performance evaluations, socializing with co-workers, and work-related social functions.

According to Schneider [8], it is possible to minimize the effect of a functional impairment by working in two different areas: the functional level of the individual and the environment. Butterfield and Ramseur [1] further summarized that types of accommodations include workplace provisions for computer technologies, environmental access such as ramps, elevators, parking and new workstations as well as structural changes to the physical workplace to promote participation in work activities including provisions for general access accommodation, floor surface changes, environmental control, signage, and evacuation routes, tool operation including telecommunication aids and assistive technology devices, workstation modifications and adaptive strategies, and seating and positioning such as equipment modifications. Zolna et al. [5] also summarized that type of accommodations include assistive technology, physical work environment, job requirements and personal assistance and training.

Finally, for accommodation strategies being suitable for workers with hearing impairments, Scherich [19] summarized devices as well as equipment, support personnel (ex:

interpreters, job coaches), job restructuring, etc. are accommodation strategies to be suitable for workers with hearing impairments. Geyer and Schroedel further identified sixteen feasible strategies, including TDD or TTY, phone amplifier, flashing lights for fire alarm, flashing lights on machines for safety, assistive listening device for meetings, pager device or beeper, e-mail, note-taking assistances by computers, sign class for co-workers who hear, co-worker takes notes for you at meetings, summary of meeting notes, interpreters, improved lighting in your work area, moved things around so you can see other people better, hearing people answer the phone, changed job duties for working better.

The extent of a functional impairment can be defined as the difference or gap between the level of function for the individual, and what the environment demands of him or her [8]. Apparently, appropriate accommodation strategies can be introduced so as to expand the capabilities, or capability set, of people with disabilities to close the gap. In the following Section, a fuzzy DEMATEL based MCDM framework will be proposed for correlating difficulties being faced by persons with hearing impairments

III. ANALYTIC FRAMEWORK FOR DEFINING ACCOMODATION STRATEGIES

The analytical process for deriving the job accommodation strategy is initiated by deriving the possible strategies and criteria being required to evaluating the strategies based on literature review. Then, the relations between the criteria will be derived by using the DEMAETL. The weights versus the criteria will be derived by using the ANP then. Finally, possible strategies will be derived by using the Grey Relation Analysis.

A. Fuzzy DEMATEL Method

The Fuzzy DEMATEL can deal with the DEMATEL problem by introducing Fuzzy linguistic variables and matrices. According to the definition of Fuzzy DEMATEL, the linguistic matrices present the relationships between criteria. In the matrices, the numeral value depicts the influence versus each criterion. Therefore, the Fuzzy DEMATEL method can transform the causes and effects relationship into a perspicuous structural model. The Fuzzy DEMATEL method has been studied and applied in many areas these years [20,21]. According to the advantages of Fuzzy DEMATEL, this research attempts to evaluate the preferences of lead users by using Fuzzy DEMATEL based on the definitions by Prof. Tzeng, Gwo-Hshiung [22]. The calculation process is demonstrated as below:

Step 1: Establishing the fuzzy linguistic scale

Establishing the linguistic sets of criteria is an essential procedure for Fuzzy DEMATEL. The major advantage of Fuzzy DEMATEL method is that it's effective to obtain the structural mode and divide the criteria into cause and effect groups, which consist of many complex aspects. To deal with the ambiguities of human feeling and evaluations, Li [23] introduces the fuzzy linguistic scale into the DEMATEL evaluation process. The strength of influence are divided into five linguistic levels as "Strong", "High", "Low", "No" and the

linguistic levels will correspond to the triangular fuzzy numbers.

Step 2: Establishing the directed relation matrix

To measure the relationship versus each criterion $C = \{c_1, c_2, \dots, c_n\}$, p lead users made evaluations in terms of linguistic terms toward the criteria. Thus, p fuzzy matrices $\tilde{Z}^1, \tilde{Z}^2, \dots, \tilde{Z}^p$ each corresponds to a lead user. The Fuzzy matrix is called the initial direct relation fuzzy matrix. For simplicity, denote $\tilde{Z}$ as $c_1, c_2 \dots c_n$, or

$$\tilde{Z} = \begin{bmatrix} c_1 & 0 & \tilde{z}_{12} & \cdots & \tilde{z}_{1n} \\ c_2 & \tilde{z}_{21} & 0 & \cdots & \tilde{z}_{2n} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ c_n & \tilde{z}_{n1} & \tilde{z}_{n2} & \cdots & 0 \end{bmatrix},$$

where $\tilde{z}_{ij} = (l_{ij}, m_{ij}, u_{ij})$ are triangular fuzzy numbers, elements $\tilde{z}_{ii} = 0, i = 1, 2 \dots n$.

Step3: Establishing the structural model

In order to transform the criteria scales into comparable scales, the linguistic scale will be transformed into a normalization formula.

$$\text{Let } \tilde{a}_{ij} = \sum_{j=1}^n \tilde{z}_{ij} = \left(\sum_{j=1}^n l_{ij}, \sum_{j=1}^n m_{ij}, \sum_{j=1}^n u_{ij} \right) \text{ and } u = \max_{1 \leq i \leq n} \left(\sum_{j=1}^n u_{ij} \right).$$

Then, the normalized direct relation fuzzy matrix, denoted by $\tilde{X}$, equals $\tilde{x} = u^{-1} \otimes \tilde{z}$. Or

$$\tilde{X} = \begin{bmatrix} \tilde{x}_{11} & \tilde{x}_{12} & \cdots & \tilde{x}_{1n} \\ \tilde{x}_{21} & \tilde{x}_{22} & \cdots & \tilde{x}_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ \tilde{x}_{m1} & \tilde{x}_{m2} & \cdots & \tilde{x}_{mn} \end{bmatrix},$$

$$\text{where } \tilde{x}_{ij} = \frac{\tilde{z}_{ij}}{u} = \left(\frac{l_{ij}}{u}, \frac{m_{ij}}{u}, \frac{r_{ij}}{u} \right). \quad (1)$$

Fuzzy DEMATEL also assume that $\sum_{j=1}^n u_{ij} < u$ and

$$\lim_{k \rightarrow \infty} \tilde{x} = [0]_{0 \times 0}.$$

Step 4: Deriving the total relation matrix

After calculating the normalized direct relation fuzzy matrix, the total relation matrix $\tilde{T}$ can be derived by the equation below:

$$\tilde{T} = \tilde{X} + \tilde{X}^2 + \cdots + \tilde{X}^n = \tilde{X}(\mathbf{I} - \tilde{X})^{-1},$$

When $\lim_{k \rightarrow \infty} \tilde{X} = [0]_{n \times n}$

$$\tilde{T} = \begin{bmatrix} \tilde{t}_{11} & \tilde{t}_{12} & \cdots & \tilde{t}_{1n} \\ \tilde{t}_{21} & \tilde{t}_{22} & \cdots & \tilde{t}_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ \tilde{t}_{m1} & \tilde{t}_{m2} & \cdots & \tilde{t}_{mn} \end{bmatrix}; \tilde{t}_{ij} = (l_{ij}^*, m_{ij}^*, r_{ij}^*)$$

$$\begin{aligned} [l_{ij}^*] &= X_l - (I - X_l)^{-1}, [m_{ij}^*] = X_m - (I - X_m)^{-1}, \\ [r_{ij}^*] &= X_r - (I - X_r)^{-1} \end{aligned}$$

Step 5: Analyzing the sum of rows and columns

The row and column sums are individually indicated the sum of rows and columns of the total relation matrix T by using following equations (2), (3), and (4),

$$\tilde{T} = [\tilde{t}_{ij}], \quad i, j \in \{1, 2, \dots, n\} \quad (2)$$

$$\tilde{r} = [\tilde{r}_i]_{n \times 1} = \left[\sum_{j=1}^n \tilde{t}_{ij} \right]_{n \times 1} \quad (3)$$

$$\tilde{c} = [\tilde{c}_j]_{1 \times n} = \left[\sum_{i=1}^n \tilde{t}_{ij} \right]_{1 \times n} \quad (4)$$

where the r and c represent the sums of the rows and columns.

Step 6: Analyzing the results from r and c

According to the sum of rows and columns, $(\tilde{r}_i + \tilde{c}_i)$ depicts the strength of the influence. If $(\tilde{r}_i - \tilde{c}_i)$ is positive, then criteria i is dispatching influence on other factors. On the other hand, if $(\tilde{r}_i - \tilde{c}_i)$ is negative, factor i is receiving influence from other criteria [20, 24, 25].

B. Analytic Network Process (ANP)

The ANP method, a multi criteria theory of measurement developed by Saaty [26], provides a general framework to deal with decisions without making assumptions about the independence of higher-level elements from lower level elements and about the independence of the elements within a level as in a hierarchy [26]. In this section, concepts of the ANP are summarized based on Saaty's earlier works [26, 27].

A component of a decision network which was derived by the DEMATEL method in Section 3.1 will be denoted by C_h , $h=1, 2, \dots, m$, and assume that it has n_h elements, which we denote by $e_{h1}, e_{h2}, \dots, e_{h n_h}$. The influences of a given set of elements in a component on any element in the decision system are represented by a ratio scale priority vector derived from paired comparisons of the comparative importance of one criterion and another criterion with respect to the interests or preferences of the decision makers. This relative importance value can be determined using a scale of 1–9 to represent equal importance to extreme importance [26]. The influence of elements in the network on other elements in that network can be represented in the supermatrix as $W_{ij} = [w_{ij}]$, $i \in \{1, 2, \dots, m\}$, $j \in \{1, 2, \dots, m\}$. A typical entry $W_{ij} = [w_{i_n x j_{n_y}}]$, $n_x \in \{1, 2, \dots, n_i\}$, $n_y \in \{1, 2, \dots, n_j\}$ in the supermatrix, is called a block of the supermatrix in the following form where each column of W_{ij} is a principal eigenvector of the influence of the elements (objective) in the i th component of the network on an element (objective) in the j th component. Some of its entries may be

zero corresponding to those elements (objective) that have no influence.

After forming the supermatrix, the weighted supermatrix is derived by transforming all columns sum to unity exactly. This step is very much similar to the concept of the Markov chain in terms of ensuring that the sum of these probabilities of all states equals 1. Next, the weighted supermatrix is raised to limiting powers, such as $\lim_{\theta \rightarrow \infty} W^\theta$ to get the global priority vector or called weights [28].

In addition, if the supermatrix has the effect of cyclicity, the limiting supermatrix is not the only one. There are two or more limiting supermatrices in this situation, and the Cesaro sum would need to be calculated to get the priority.

The weights of the k^{th} criteria being derived by using the above ANP processes, namely ω_k , $k \in \{1, 2, \dots, n\}$, will be used as the weight for the k^{th} criteria in the following Section 3.3.

C. GRA

GRA is used to determine the relationship between two sequences of stochastic data in a Grey system. The procedure bears some similarity to pattern recognition technology. One sequence of data is called the 'reference pattern' or 'reference sequence,' and the correlation between the other sequence and the reference sequence is to be identified [29–32]. To apply the GRA, definitions were cited from the early works by Tzeng and Huang [25, 33].

According to Deng, the mathematical equation for deriving the grey relation coefficient is:

$$\begin{aligned} \gamma(x_0(k), x_i(k)) &= \\ &= \frac{(\min_{\forall i} \min_{\forall k} |(x_0(k) - x_i(k))| + \zeta \max_{\forall i} \max_{\forall k} |(x_0(k) - x_i(k))|)}{(|(x_0(k) - x_i(k))| + \zeta \max_{\forall i} \max_{\forall k} |(x_0(k) - x_i(k))|)^{-1}} \end{aligned}$$

where ζ is the distinguished coefficient ($\zeta \in [0, 1]$). Generally, we pick $\zeta = 0.5$. When the grey relational coefficient is conducted with respect to the courses, we then can derive the grade of the grey relation $\gamma(x_0, x_i)$ between the reference alternative $\gamma(x_0, x_i) = \sum_{k=1}^n n^{-1} \gamma(x_0(k), x_i(k))$, where k is the number of capabilities while the weight being associated to the criterion is assumed to be equal. $\gamma(x_0, x_i)$ represents the grade of grey relation in x_i (the k^{th} strategy) correspondence to x_0 . In this study, we make the order of the strategies following the grade of grey relation.

IV. ACCOMODATION STRATEGY DEFINITIONS FOR OPERATORS WORKING IN THE ELECTRONIC INDUSTRY

The electronic industry of the developed East Asian countries, including Japan, South Korea and Taiwan have already been well developed and contributed to a significant percentage of the GDPs of the countries. In Taiwan, the electronic industry has also become the major source of job vacancies for workers with disabilities. In the electronic factories, operators accounted for significant share of the total employers. To maximize the capability of operators with disabilities in general and the hearing impaired operators in

special, an empirical study based on interviews of the Taiwanese hearing impaired operators as well as an industry expert was introduced for verifying and demonstrating the feasibility of the proposed Fuzzy DEMATEL based MCDM framework for job accommodation strategy definitions.

Based on the interview results from seven operators who have been working in Taiwanese high technology firms, including the semiconductor testing houses as well as liquid crystal display panel vendors, following work barriers were summarized: colleagues' low/no intention to communicate by pen (p_1), managers' terrible attitude (p_2), noisy work environment (p_3), no hearing aid or requirements for better hearing aid (p_4), lip reading difficulties (p_5), no idea regarding to how capabilities can be enhanced (p_6), requirements in word processing software training (p_7), and no idea(s) regarding to possibilities of career development (p_8).

Since the former accommodation strategies being proposed by Geyer and Schroedel [3] cannot fulfill the needs of the electronic industry, seven novel accommodation strategies are proposed. The strategies include the electronic white board (a_1), digital electronic hearing aid (a_2), summary meeting notes (a_3), interpreters (a_4), on-job training of computer software (a_5), career planning courses (a_6) as well as assistances by hearing co-worker(s) (a_7).

At first, according the expert's opinion, the linguistic variables can be defined as Figure 1(a) while the initial direct relation fuzzy matrix $\tilde{Z}$ can be defined as Figure 1(b).

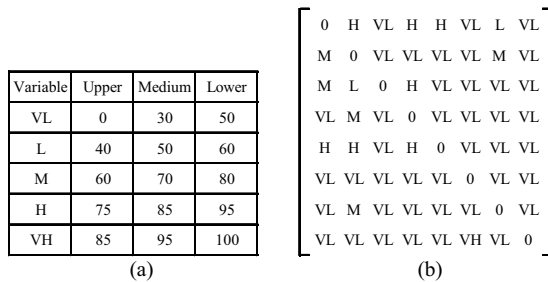


Figure 1. (a) Linguistic variables and (b) the fuzzy matrix $\tilde{Z}$

Then, by introducing the Fuzzy DEMATEL ANP process being introduced in Section 3, the weights being associated with each work barrier can be derived (see Table I).

Table I. The weights versus criteria									
Barrier	p_1	p_2	p_3	p_4	p_5	p_6	p_7	p_8	Sum
Weight	0.133	0.133	0.167	0.167	0.133	0.100	0.067	0.100	1.000

Finally, by introducing the GRA being introduced in Section 3.3, the Grey grades versus each accommodation strategy can be derived (see Table II). Based on the derivation results, the electronic white board (a_1), digital electronic hearing aid (a_2), interpreters (a_4), and assistances by hearing co-worker(s) (a_7) are the most helpful strategies.

Table II. The Grey Coefficients and Grey Grades

Barrier	p_1	p_2	p_3	p_4	p_5	p_6	p_7	p_8	Grey Grades
Strategy									
a_1	0.133	0.067	0.167	0.056	0.089	0.033	0.022	0.033	0.511
a_2	0.133	0.133	0.111	0.167	0.133	0.033	0.022	0.033	0.678
a_3	0.089	0.089	0.056	0.056	0.089	0.033	0.022	0.033	0.378
a_4	0.133	0.089	0.167	0.056	0.133	0.033	0.022	0.033	0.578
a_5	0.044	0.089	0.056	0.056	0.044	0.033	0.067	0.033	0.289
a_6	0.044	0.053	0.056	0.056	0.044	0.100	0.033	0.100	0.253
a_7	0.133	0.133	0.167	0.167	0.133	0.050	0.044	0.050	0.733

V. DISCUSSION

In this research, accommodation strategies for hearing impaired operators were derived by introducing the Fuzzy DEMATEL based MCDM approach. Following, the managerial implications as well as advances in research methods of job accommodation strategy definitions will be discussed.

For the accommodation strategies being suitable for the electronic industry, the past researches or assistive technologies are very limited. The accommodation strategies being developed one decade ago cannot fulfill modern requirements. Further, modern electronic technologies have already advanced the assistive technologies. Apparently, updates of both work barriers in the modern industry as well as available accommodation strategies are very helpful. The research results being demonstrated in this paper advanced both aspects of the job accommodation strategies as well as work barriers in the electronic industry.

For the research results, the electronic white board, digital electronic hearing aid, interpreters, and assistances by hearing co-worker(s) are the most helpful accommodation strategies. However, these results were derived based on one expert's opinion by summarizing interview results of the hearing impaired operators. How the accommodation strategies can be derived based on the viewpoints of the business managers will also be very helpful and make the accommodation strategies really feasible. Thus, further researches by introducing the opinions from the industry managers, experts from the academic or social welfare institutes as well as the hearing impaired operators will be very helpful.

For the advances in incorporating the idea of MCDM into researches of accommodation strategy definitions, the perfect match between the MCDM methods as well as the job accommodation strategy definition process being proposed by the job accommodation procedure being proposed by Schneider [8] have already been addressed in the first Section. Further, the empirical study based on the case studies on the hearing impaired operators from the electronic industry has verified the effectiveness of the proposed MCDM framework. In the future, the MCDM framework can be applied in the job accommodation strategy definition problems for other disabilities. Meanwhile, the effectiveness of the strategies can further be compared with the job accommodation strategies being derived by other research methods.

VI. CONCLUSIONS

Job accommodation strategies have become daily important for the people with disabilities in general and hearing impaired people in special. However, very few researches have been developed on how the job accommodation strategies can be defined. Meanwhile, job accommodation strategy definitions based on research results being developed one decade ago are not feasible for modern

industries. In this paper, the fuzzy DEMATEL based MCDM framework was first introduced into the job accommodation strategy definition problem due to the nature match between the job accommodation strategy definition process as well as the MCDM framework. An empirical study based on the operators from the electronic industry advanced and verified both available job accommodation strategies as well as job accommodation research methods. In the future, the proposed strategies as well as the research framework can be used to enhance the welfare of the disabilities.

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