AWARENESS OF UNIVERSAL DESIGN AMONG FACILITY MANAGERS IN JAPAN AND THE UNITED STATES

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Abstract

The progress of aging society requires companies to broaden the range of employment opportunities to be provided from "traditional" businessmen to more diverse workers including elderly people and those with disabilities. Meanwhile, many successful companies practice workforce diversity as a corporate strategy to survive recent intensive economic competitions. One of the important responsibilities of current facility managers is to prepare workplaces to be able to accommodate the widest range of workers as much as possible. The adaptation of universal design will support workplace diversity from the standpoint of facility management.

The Universal Design Research Committee of the Japan Facility Management Promotion Association (JFMA-UD) is conducting research aimed at verifying the effectiveness of universal design in the workplace. As part of its research, JFMA-UD has conducted two surveys, one in Japan and the other in the United States. These surveys cover the awareness and practice of universal design among facility managers. This paper will present a comparative analysis of these surveys and discuss problems and possible solutions in the application of universal design in the workplace.

Keywords: accessibility; diversity; survey; universal design; workplace

INTRODUCTION

Japan is rapidly becoming an aging society. It has been estimated that the population in Japan will decline to 92 million people by 2050, 39% of whom will be age 65 and over at that time. It is further estimated that the population of the workforce between the ages of 15 and 64 will decline to 70 million in 2028, and only 49 million in 2050 (National Institute of Population and Social Security Research 2002). Another critical issue facing Japan is the employment of people with disabilities. In 2001, the number of non-institutionalized people aged 18 and over with physical and/or intellectual impairments was estimated to be about 3.5 million, an increase of 8.7% since 1996 (Ministry of Health, Labour and Welfare [MHLW] 2001; 2002). Of this number, only 190,000 (5.8%) were actually employed by public or private sector organizations.

The dynamic change of Japanese demographics will broaden the diversity of the workforce, including elderly people and people with disabilities, which will definitely transform future work environments. To prepare the workplace for the increasing diversity of employees, the Japan Facility Management Promotion Association's (JFMA) Universal Design Research Committee (JFMA-UD) is working to establish universal design guidelines for the workplace.

As part of our ongoing research regarding the effectiveness of universal design in the workplace, the purposes of this study are to understand how facility managers recognize and practice universal design in their workplaces and to establish what factors facilitate or obstruct these practices. Two surveys have been conducted in this study: one in Japan and the other in the United States. By comparing results between these two countries, we aimed to establish common problems/solutions of universal design practices in these countries and problems/solutions that depend on cultural, political, and social differences.

LITERATURE REVIEW

Universal design is defined as the "design of products and environments usable by all people to the greatest extent possible, without the need for adaptation or specialized design (Center for Universal Design 1997)." Applicable to all ages, personal abilities and sizes, with an inclusive power that transcends barrier-free and accessible design, universal design was coined in 1985 by Ronald Mace, an architect who had a disability. This concept has been accepted in a variety of fields, such as architecture, engineering, product design, and landscape design.

To date, universal design in architecture has been studied mainly in terms of physical accessibility and usability in public spaces and private houses, but only a few studies have focused on its relevance in the workplace. Mueller (2001) has developed several guidelines to apply universal design in the workplace from an ergonomic perspective (e.g., Herman Miller 1994; U.S. Department of Defense 1998). JFMA-UD is also establishing guidelines to develop the strategies of workplace universal design in conjunction with corporate management (in press). Preiser (2001a; 2001b) has discussed the application of universal design to post-occupancy evaluation of office buildings.

Meanwhile, it has been about two decades since the concept of universal design was first originated, and it is interesting to see how practitioners now recognize it and to what extent they have applied it to their practices. In the field of product design, Vanderheiden and Tobias (n.d.) studied motivators and barriers to the implementation of universal design, and possible strategies to improve the awareness of universal design. Another relevant study is Bruyere's study (2000) regarding the practices of both private companies and U.S. Federal agencies in providing reasonable accommodations for employees with disabilities in the workplace. Although this study does not focus primarily on universal design but on the implementation of Title I of the Americans with Disabilities Act of 1990 (ADA), these surveys asked human resource professionals about accommodations they provided in their workplaces and obstacles they faced in providing accommodations. These two studies revealed the present state of the awareness and practices of universal design among practitioners in certain fields; however, there has been no study from the perspective of facility management. The question still remains – what are similarities beyond the fields and what are the issues peculiar to facility managers?

METHODOLOGY

To explore the awareness of universal design among facility managers, we conducted two questionnaire surveys: one in Japan and the other in the United States. The subject of both surveys was in-house facility managers. The questionnaires for both surveys were self-administered with multiple-choice questions. The questionnaires in these surveys featured the same questions and answer options, so that the surveys' results could be compared. However, the options for answers in a couple of questions were adjusted to reflect the circumstances of each country (for example, the difference in legal requirements). Some questions were added to the questionnaire for the U.S. survey.

The main focus of both surveys was on the following five perspectives: (1) The degree of the recognition of universal design; (2) The degree of the practice of universal design; (3) The expectation of changing the employment of diverse workers, such as elderly workers and those with disabilities; (4) Advantages and disadvantages of applying universal design; and (5) Obstacles to the introduction of universal design. Since we had assumed that barrier-free design and accessible design were more popular terms than universal design in Japan, some questions were designed to comparatively identify different circumstances of these two concepts.

Survey in Japan

The first survey was conducted in Japan from January 29 to February 14, 2003. The digital file of the questionnaire with 14 questions was distributed via e-mail to 3,033 facility managers who subscribed to the JFMA mailing list. Completed questionnaires were returned to JFMA via facsimile or e-mail. Of those who received the questionnaire, 63 persons (2.1%) responded.

Survey in the United States

The second survey is being conducted in the United States from May 25 to June 7, 2004 in collaboration with the International Facility Management Association (IFMA). An on-line questionnaire with 17 questions was developed. Invitation e-mails were sent out to about 1,400 IFMA members who worked as

in-house facility managers in the United States and respondents filled out their questionnaires on-line. As of May 29, 2004, 114 persons (8.1%) had responded.

FINDINGS OF THE SURVEY IN JAPAN

The results of the survey conducted in Japan show that although universal design has not yet been broadly practiced in the workplace, many Japanese facility managers recognize its advantages and more organizations are expected to introduce universal design in their workplaces in the future. This finding proves there is a strong need for financial support to provide universally accessible and usable workplaces, as well as the necessity of educational systems for practitioners to increase their knowledge and experiences. Following are the highlights of the results of the survey.

Profile of the respondents

Eighty nine percent of the respondents worked for Japanese companies or organizations, whose major origin of capital is Japan. Eleven percent of them represented international companies, which were based in Japan but whose major capital came from other countries. In terms of industry representation, 76% of the respondents belonged to service industries, 17% worked in manufacturing, and 7% worked in government agencies, education, or other organizations. Forty five percent of the respondents worked for companies less than 100 occupants on site, 42% came from companies with between 100 and 999 occupants, and 23% of them worked for companies where there were 1000 occupants or more. Regarding the type of building occupancy, 44% of the workplaces surveyed were owner occupied, 39% were leased buildings that the respondents' companies partially occupied, and 19% were leased and the respondents' companies occupied the entire building.

Degree of the recognition of universal design

The results show that the terms *barrier-free design* and *universal design* were well known among Japanese facility managers, although universal design was less familiar than barrier-free design. Ninety two percent of the respondents said that they knew *barrier-free design* well, whereas 77% said they knew *universal design* well (see Figure 1). This can be explained by the facts that the concept of universal design is relatively new to Japanese people compared to barrier-free design. Furthermore, barrier-free design is integrated into the Japanese accessibility regulations (for example, the Law for Buildings Accessible to and Usable by the Elderly and Physically Disabled Persons [the Heartful Building Law]).

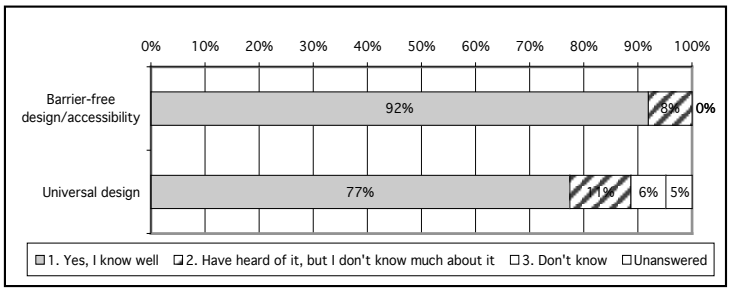

Figure 1: Familiarity with the terms *barrier-free design/accessibility* and *universal design* (Japan)

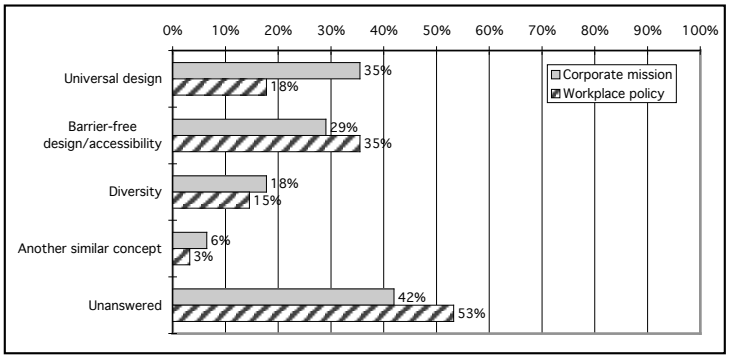

Figure 2: Concepts included in corporate mission and workplace policies (Japan)

Fifty eight percent of the respondents answered that universal design or barrier-free design was a part of their corporate mission. Universal design was more likely to be integrated into corporate missions than barrier-free design (35% vs. 29%, respectively). Meanwhile, 47% of the respondents answered that their companies had incorporated universal design or barrier-free design into their workplace policies, but that universal design was less likely than barrier-free design to be integrated into workplace policies (18% vs. 35%, respectively) (see Figure 2). From these results, it can be concluded that universal design is more likely to be in corporate

missions and less likely to be integrated into workplace policies although the term *universal design* has been widely spread among Japanese facility managers.

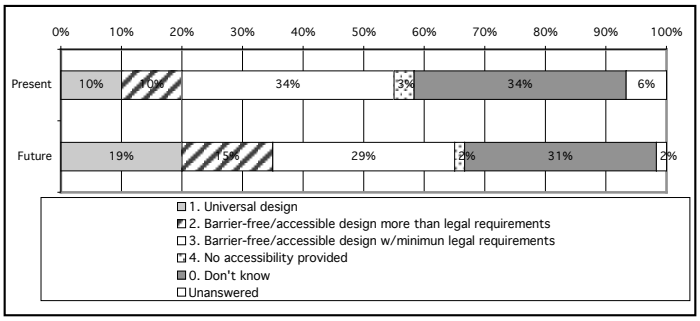

Figure 3: Degree of the present practice of universal design or accessibility/barrier-free design and its anticipated practice in the future (Japan)

Degree of the practice of universal design: present and future

Only 20% of the respondents said their workplaces currently provided universal design and/or beyond the legally required level of barrier-free design; whereas 34% of the respondents said their workplaces provided only the minimum of the legally required barrier-free design (see Figure 3).

Regarding the expectation of future practices, the respondents overall showed a willingness to increase the degree of practices. Thirty four percent of them expressed their desire to introduce universal design and/or beyond the legally required level of barrier-free design in their workplaces in the future.

Meanwhile, more than 30% of the respondents answered "don't know" for both present and future practices, which suggests that it is necessary to increase awareness of the importance of universal design among Japanese facility managers.

Expectation to change the employment of diverse workers

Although more than 60% of the companies surveyed were positive about hiring people with disabilities in future, more than 50% of the respondents thought it would be unlikely that they would increase their quota of elderly employees. This attitude reflects, in part, the tendency of Japanese companies to lower the retirement age.

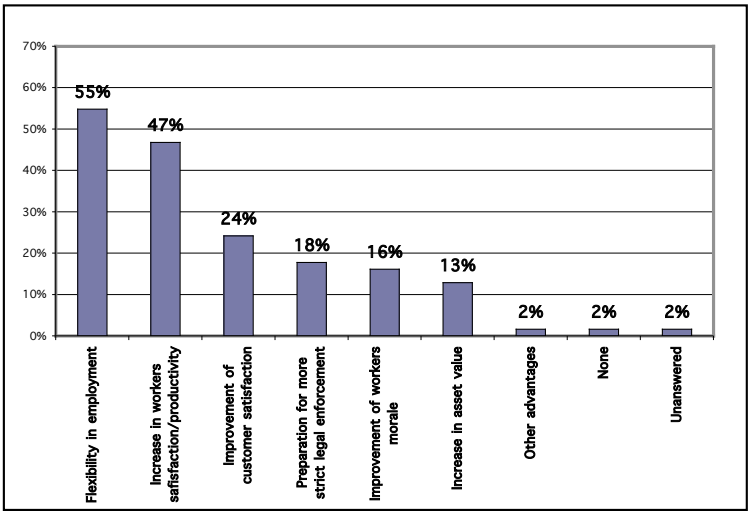

Figure 4: Expected advantages of applying universal design (Japan)

Advantages and disadvantages of applying universal design

Anticipated advantages the respondents cited most frequently were: "improvement of a corporate reputation (60%)," "flexibility of human resources (55%)," and "an increase in worker satisfaction and productivity (47%)." Only 13% of them expected "an increase of facilities' asset values," which means that not many facility mangers recognized the relevance of universal design to asset management (see Figure 4).

Meanwhile, many facility managers were concerned about cost issues if they applied universal design. The most frequently cited disadvantages they expected included "an increase in construction costs (55%)" and "inefficiency of space usage (37%)." On the other hand, 24% of

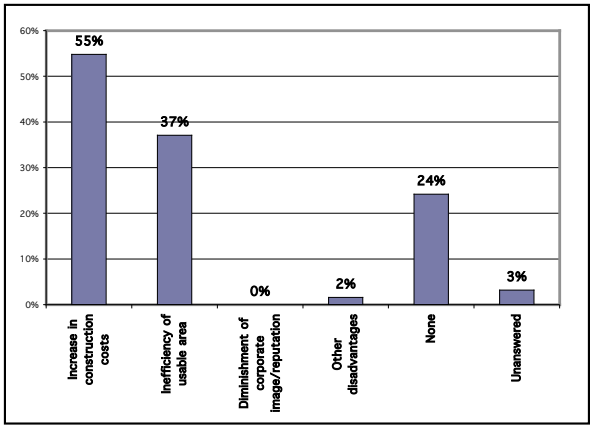

Figure 5: Expected disadvantages of applying universal design (Japan)

them said no disadvantages were expected; more facility managers than we had assumed anticipated that universal design would not bring any negative effects to companies (see Figure 5).

Obstacles to the introduction of universal design

Seventy three percent of the respondents were concerned about cost issues as an obstacle to the introduction of universal design or barrier-free design. This was consistent with the result of the previous question regarding anticipated disadvantages. Other concerns were lack of experiences and/or knowledge (21%) and understanding by management (19%) (see Figure 6).

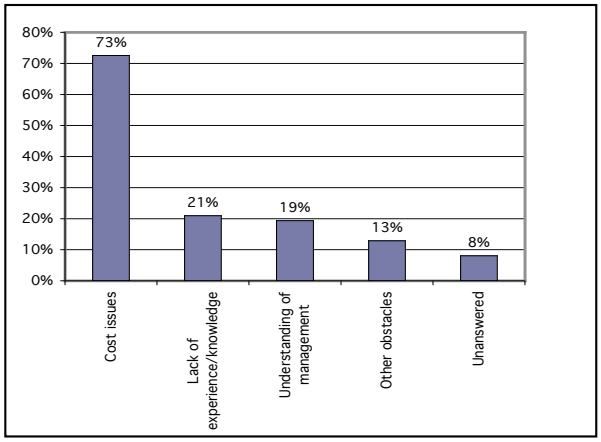

Figure 6: Obstacles to introduction of universal design (Japan)

FINDINGS FROM THE SURVEY IN THE UNITED STATES

Because the U.S. survey has not yet been completed, we cannot show its final results here. However, it is possible to mention here some notable tendencies found from the data collected so far. Following are the tentative findings as of May 30, 2004. The final results will be presented later.

Profile of the respondents

Most of the respondents' organizations (61%) had their headquarters in North America and 39% failed to answer this question. In terms of industry representation, 32% of the respondents belonged to service industries, 17% worked in manufacturing, and 12% worked in government agencies, education, or other organizations; 39% of the questionnaires were unanswered. Three percent of the respondents worked for companies where there were less than 100 occupants at their workplaces; 37% of them worked for companies whose workplaces housed between 100 and 999, and 21% were from workplaces with 1000 or more occupants; 39% were unknown. Regarding the type of building occupancy, 33% of the workplaces surveyed were owner occupied, 14% were leased buildings that the respondents' companies partially occupied, and 11% were leased and the respondents' companies occupied the entire buildings.

Degree of the recognition of universal design

The results show that most U.S. facility managers were familiar with the term *barrier-free design* or *accessibility*, but the term *universal design* was not well-known among them. Sixty eight percent of the respondents said they knew *barrier-free design* or *accessibility* well, whereas only 28% said they knew *universal design* well (see Figure 7). It is easily assumed that the popularity of barrier-free design or accessibility is an effect of the long history of U.S. accessibility regulations, such as Section 504 of the Rehabilitation Act of 1973 and the Americans with Disabilities Act of 1990. However, despite the long history of the regulations, 31% of the respondents said that they still did not know much

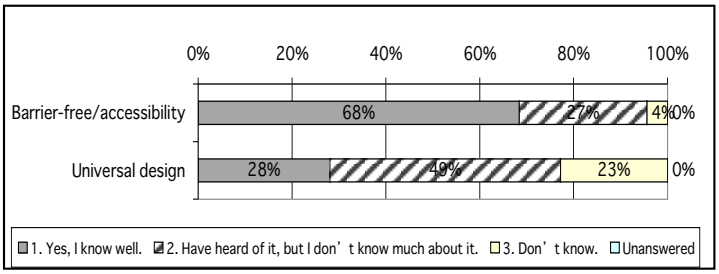

Figure 7: Familiarity with the terms barrier-free design/accessibility and universal design (U.S.)

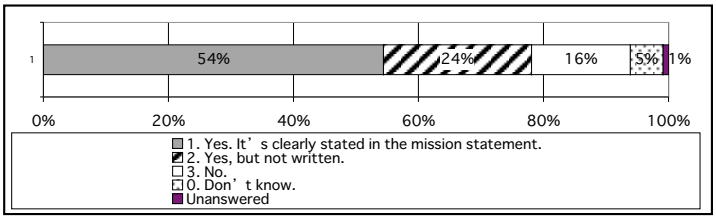

Figure 8: Trend of the answers to the question whether the concept of diversity is stated in corporate mission. (U.S.)

about barrier-free design/accessibility. Combined with the fact that 72% of them were unfamiliar with universal design, the reasons for there results should be investigated further.

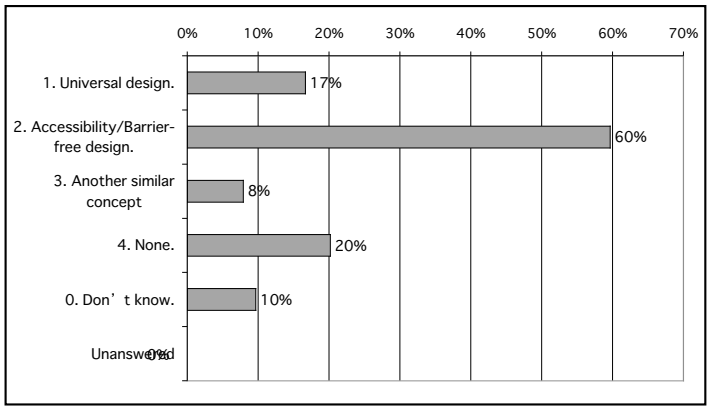

Figure 9: Concepts included in workplace policies (U.S.)

Meanwhile, many U.S. organizations seemed to have prepared their corporate missions and workplace policies for the employment of diverse workers. Seventy eight percent of the respondents answered that the concept of diversity was a part of their corporate mission (see Figure 8). Sixty percent of the respondents answered that their companies had incorporated barrier-free design/accessibility into their workplace policies. Seventeen percent of them said universal design was included in their workplace policies. On the other hand, 30% of the respondents answered that they had no policies related to either universal design or barrier-free design/accessibility or they did not know if they had the related policies (see Figure 9). This means there is still room to improve the awareness of the importance of universal design.

Degree of the practice of universal design: present and future

A majority of the respondents (59%) answered that their workplaces currently provided the minimum requirements of the Americans with Disabilities Act Accessibility Guidelines (ADAAG). Twenty six percent of the respondents said their workplaces currently provided more than the legally required level of barrier-free design/accessibility, but only 2% of them said their workplaces provided universal design (see Figure 10). This is probably related to the unfamiliarity of universal design, as the previous result showed.

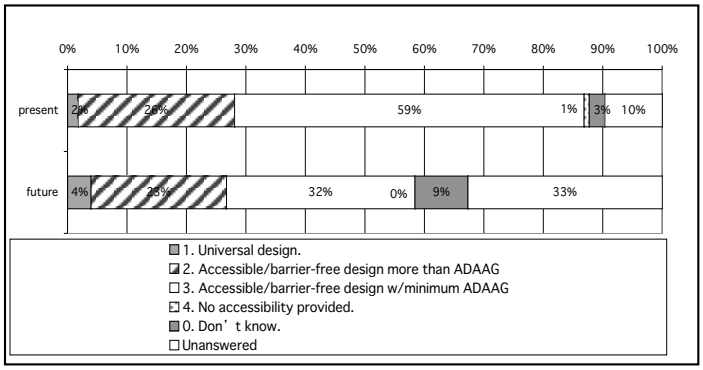

Figure 10: Degree of the present practice of universal design or accessibility/barrier-free design and its anticipated practice in the future (U.S.)

(The results regarding the expectation of future practices will be shown later because further analysis is needed for them.)

Expectation to change the employment of diverse workers

In the U.S. survey, we asked the participants to indicate their expectation of future change in the number of workers in the following six categories: workers over the age of 65, workers with physical disabilities, workers with psychiatric or intellectual disabilities, foreign workers who have difficulty in communicating in English, workers who are pregnant, and workers who have extremely large or small physique compared to the average. Overall, the respondents most frequently answered that they expected "no change" or "minor increase" for all of these six categories. However, in the categories other than "workers over the age of 65" and "workers with physical disabilities," "no change" was most frequently cited.

Advantages and disadvantages of applying universal design

For the expected advantages of universal design, respondents most frequently said that it would "allow us more flexibility to employ diverse workers (56%)," "improve workers' productivity and/or satisfaction (50%)," and "enable us to reduce legal risks and/or workers compensation claims (50%)." Forty three percent of the respondents also said it would "reduce alteration and maintenance costs" (see Figure 11).

Regarding the expected disadvantages, 39% of the respondents were concerned about an increase in construction costs. This result indicates that many U.S. facility managers thought that applying universal design would make initial construction costs higher, but that it would make facilities' running costs lower. Meanwhile, 20% of the respondents expected no disadvantages (see Figure 12).

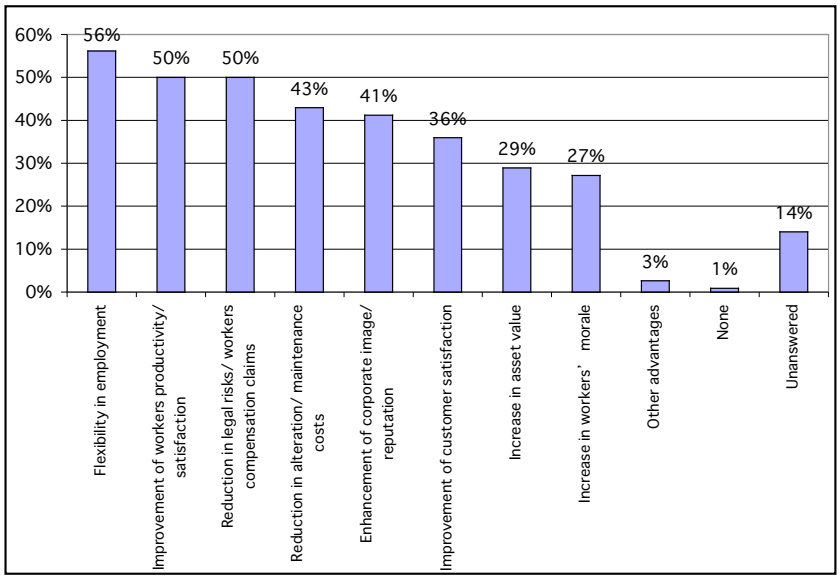

Figure 11: Expected advantages of applying universal design (U.S.)

Obstacles to the introduction of universal design

Fifty four percent of the respondents regarded cost issues as an obstacle in introducing universal design to their workplaces, followed by a lack of experiences/knowledge (37%) and understanding of executives (32%) (see Figure 13).

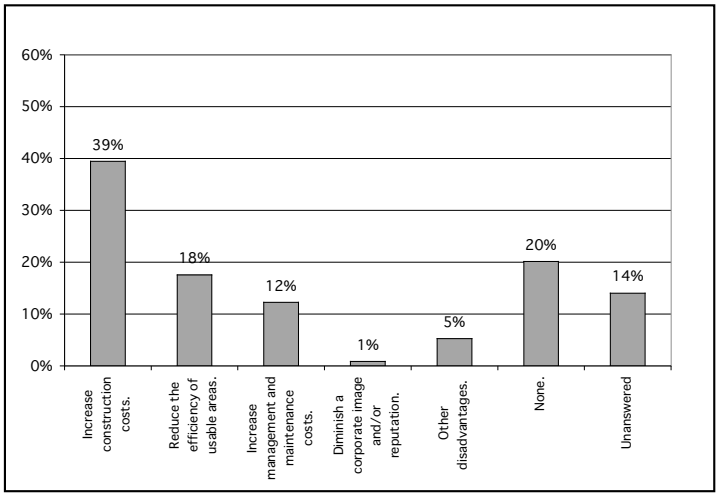

Figure 12: Expected disadvantages of applying universal design (U.S.)

IMPLICATIONS OF A COMPARISON BETWEEN JAPAN AND THE UNITED STATES

Since these two surveys were conducted at different times and in different manners, it would not be appropriate to directly compare the results of these two surveys without careful consideration. However, some of the fundamental tendencies established from these surveys can be comparatively analyzed. Following is a brief analysis made by comparing these two surveys.

Difference in response rate

While the response rate of the U.S. survey was about 8%, that of the Japanese survey was only 2%. There may be several reasons for this difference – for example, the different methods used in collecting the questionnaires and cultural differences in attitudes towards participating in public events. However, one of the reasons for the low response rate in

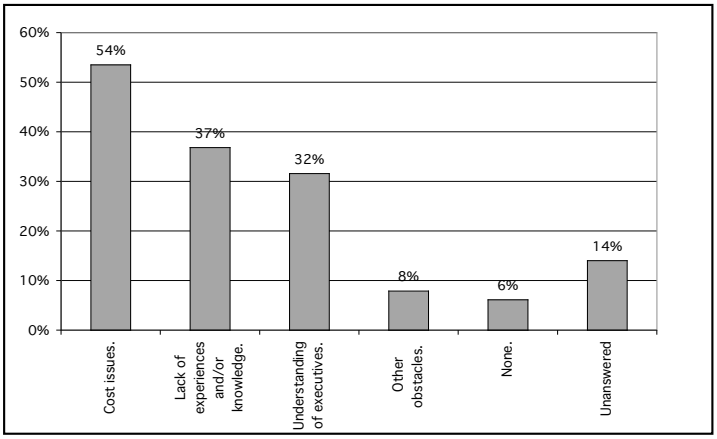

Figure 13: Obstacles to introduction of universal design (U.S.)

the Japanese survey may be because of a lack of interest or viewpoint on the issue among Japanese facility managers. In general, they may not feel universal design or accessibility issues are familiar to them in their daily practices. This is consistent with the fact that the employment rate of people with disabilities in Japan is still low. This implies a need for further efforts to raise the awareness of the issue through education and communication, in collaboration with both facility management and human resource management.

Correlation between the degree of recognition and that of practices

Regarding the familiarity of the terms *barrier-free design/accessibility* and *universal design*, more Japanese facility managers are familiar with both terms than U.S. facility managers. This is an interesting finding – generally speaking, the United States is regarded as having a longer history of disability rights movements and accessibility regulations than Japan. In addition, the concept of universal design was originally coined in the United States. We had assumed, therefore, that these terms have taken firmer root among U.S. facility managers than their Japanese peers before the surveys. The popularity in Japan can be explained, in part, by the recent tendency in the field of product design, in which many manufacturers and advertising agencies focus on universal design as a new marketing strategy to get out of the long business recession. The recent amendment of the Japanese accessibility law could be another reason for the increase in the popularity of these terms. However, it is still uncertain why these terms are less familiar to U.S. facility managers, and the subject should be investigated in more depth.

In the meantime, about 70% of the organizations in the United States have included universal design or barrier-free design/accessibility in their workplace policies, and more than 80% of them satisfy at least the minimum requirements of accessibility regulations in their workplaces. On the other hand, only about 50% of the organizations in Japan have included universal design or barrier-free design/accessibility in their workplace policies and provide at least the minimum requirements of accessibility regulations in their workplaces. This result indicates that the familiarity of Japanese facility managers with universal design or barrier-free design/accessibility does not mean they have subscribed to its practices. Japanese facility managers are less likely than their U.S. counterparts to practice universal design or barrier-free design/accessibility in their workplaces even though they do know these concepts well.

A reason for this difference can be because of the difference in legal enforcement. Unlike U.S. accessibility laws, Japanese accessibility law has just been amended to mandate the provision of accessibility to specified types of buildings. Importantly, office buildings are not included and the provision of accessibility is still "voluntarily obligated." From these results, we can assume the effectiveness of legislation to promote practices of accessibility and usability for diverse workers. However, looking at the relation between the degree of recognition and that of practices in the U.S. survey, it is possible that some U.S. facility managers practice workplace accessibility just because it is legally required, without understanding real user needs or verifying its effectiveness for their own organizations. This is supported by the fact that the majority of the survey respondents indicated that they provided only the minimum requirements stipulated by accessibility regulations and less respondents' organizations seemed willing to provide accessibility beyond what the regulations required.

Therefore, it will be necessary to establish effective approaches to the strategic application of universal design for the corporate management of both Japanese and U.S. facility managers. It is important that Japanese facility managers bring their recognition to their practices and for U.S facility managers to be educated about further meaningful practices beyond the implementation of regulations.

Reflection of corporate missions to universal design practices

Not surprisingly, U.S. organizations were more likely than Japanese organizations to address "diversity" in their corporate missions (78% vs. 18%, respectively). This result apparently reflects environmental difference in social structure between Japan and the United States. This tendency seems to be closely related to the fact that more than 80% of the U.S organizations, or 1.5 times that of Japanese organizations, have already adopted universal design or the legally required level of barrier-free design.

Advantages in applying universal design

The results from both surveys show similar tendencies regarding the expected advantages of universal

design. In both surveys, facility managers largely expected that universal design would allow them more flexibility in employment and improve workers satisfaction and productivity. Interestingly, Japanese facility managers showed their expectation of improved corporate images/reputations more frequently than U.S. facility managers (60% vs. 41%, respectively). On the other hand, U.S. facility managers more frequently cited the effectiveness of universal design in reducing regal risks or compensation claims than their Japanese peers (50% vs. 18%, respectively). Overall, it seems that U.S. facility managers are more likely than Japanese facility managers to expect practical and direct benefits from the application of universal design, whereas Japanese facility managers are more likely than their U.S. counterparts to expect its benefits from indirect and longitudinal perspectives. This tendency is a reflection, in part, of the difference in a management style between Japan and the United States.

Relationship between disadvantages and obstacles

Participants of the survey in both Japan and the United States regarded an increase in construction costs and inefficiency of space usage as major disadvantages in applying universal design. This is consistent with the result that cost issues were the most frequently cited obstacle to the introduction of universal design. Japanese facility managers were more like than their U.S. peers to be concerned about cost issues in terms of both disadvantages and obstacles – one of the reasons would be that real estate prices in Japan are much higher than those in the United States.

This is a very interesting result when we compare it to the result of Bruyere's survey in which she asked human resource professionals about barriers to employment for people with disabilities (2000). This survey shows that the biggest concern for human resource professionals was a lack of experience, and they did not care about cost issues as much as facility managers did in our surveys. Therefore, from facility management's perspective, it will be particularly important to seek solutions to cost issues through a variety of efforts, such as financial incentives. As some of the respondents in the U.S. survey mentioned, the marketing efforts of suppliers to provide better services and materials at a low price will also be effective; this is one of the fundamental principles of universal design, marketability.

Meanwhile, one-fifth to a quarter of the respondents in both surveys said that there would be no disadvantages if they applied universal design. This implies that many facility managers may be prevented from practicing universal design by some obstacles or they may not be motivated enough to practice it even though they do not see any disadvantages.

CONCLUSION

Through these surveys in Japan and the United States, we found that overall many facility managers in both countries greatly recognized the advantages of applying universal design in their workplaces. However, the surveys showed that most organizations currently provided accessible workplaces only within the scope of legal requirements and there was a high possibility of being able to improve universal design practices. In order to further facilitate universal design practices in the workplace, it will be important to verify its advantages and disadvantage from real case studies and to collect data that can be used for the decision-making of facility managers and corporate executives. This will be our next goal and we hope to present several case studies in the near future.

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REFERENCES

Bruyere, S. 2000. *Disability employment policies and practices in private and federal sector organizations*. Cornell University, School of Industrial and Labor Relations Extension Division, Program on Employment and Disability, Ithaca, NY.

Center for Universal Design. 1997. *The Principles of Universal Design, Ver. 2.0*. North Carolina State University, Raleigh, NC.

Herman Miller, Inc. 1994. *Designing for accessibility: Application guide*. Herman Miller, Zeeland, MI.

JFMA-UD (Japan Facility Management Promotion Association, The Universal Design Research Committee). in press. *Office no Universal Design ni Mukete (Toward Universal Design at Offices).* Japan Facility Management Promotion Association, Tokyo, Japan.

Mueller, J. L. 2001. Office and workplace design. In W. F. E. Preiser & E. Ostroff (eds.), *Universal design handbook.* McGraw-Hill, New York, NY, pp.45.1-45.11.

Ministry of Health, Labour and Welfare (MHLW). 2001. *Chiteki-Shogaiji(sha) Kiso Chosa Kekka no Gaiyo (A Basic survey on People with Cognitive Impairments 2000: The Summary of the Results)* [online]. Sep. 2001. Retrieved Jul. 18, 2002, from http://www.mhlw.go.jp/houdou/0109/h0919-3.html.

MHLW. 2002. *Shintai-Shogaiji(sha) Jittai Chosa Kekka no Gaiyo (A Survey on the Actual Conditions of People with Physical Impairments 2001: The Summary of the Results)* [online]. Apr. 2002. Retrieved Jul. 18, 2002, from http://www.mhlw.go.jp/houdou/2002/04/h0411-2.html.

National Institute of Population and Social Security Research. 2002. *Nihon no Shorai Suikei Jinko: Heisei 14 nen 1 gatsu Suikei [Population Projection for Japan: 2001-2050]* [online]. Jan. 2002. Retrieved Jun. 17, 2002, from http://www.ipss.go.jp/Japanese/newest02/newest02.html.

Preiser, W. F. E. 2001a. The evolution of post-occupancy evaluation: Toward building performance and universal design evaluation. In Federal Facilities Council (Ed.), *Learning from our buildings: A state-of-the-practice summary of post-occupancy evaluation.* National Academy Press, Washington, DC, pp. 9-22.

Preiser. W. F. E. 2001b. Toward universal design evaluation. In W. F. E. Preiser & E. Ostroff (eds.), *Universal design handbook.* McGraw-Hill, New York, NY, pp.9.1-9.18.

U.S. Department of Defense. 1998. *The workplace ergonomics workbook: An illustrated guide to assessing ergonomic needs in the office workplace and planning effective solutions*. U.S. Department of Defense, Washington, DC.

Vanderheiden, G. & Tobias, J. n.d. *Barriers, Incentives and Facilitators for Adoption of Universal Design Practices by Consumer Product Manufacturers* [online]. Retrieved May 27, 2004, from Trace R&D Center Website http://trace.wisc.edu/docs/hfes98_barriers/barriers_incentives_facilitators.htm.