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# The Effect of Micro and Macro Stressors in the Work Environment on Computer Professionals' Subjective Health Status and Productive Behavior in Japan

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**Abstract: To investigate the effect of micro and macro stressors in the work environment on the subjective health status and productive behavior of computer professionals, we conducted a web-based investigation with Japanese IT-related company employees in 53 company unions. The questionnaire consisted of individual attributes, employment characteristics, working hour characteristics, company size and profitability, personal characteristics (i.e., Growth Need Strength), micro and macro stressors scale, and four outcome scales concerning the subjective health status and productive behavior. We obtained 1,049 Japanese IT-related company employees' data (response rate: 66%), and analyzed the data of computer engineers (80%; n=871). The results of hierarchical multiple regressions showed that each full model explained 23% in psychological distress, 20% in cumulative fatigue, 44% in job dissatisfaction, and 35% in intentions to leave, respectively. In micro stressors, "quantitative and qualitative work overload" had the strongest influence on both the subjective health status and intentions to leave. Furthermore, in macro stressors, "career and future ambiguity" was the most important predictor of the subjective health status, and "insufficient evaluation systems" and "poor supervisor's support" were important predictors of productive behavior as well. These findings suggest that improving not only micro stressors but also macro stressors will enhance the subjective health status and increase the productive behavior of computer professionals in Japan.**

**Key words:** Micro and macro stressors, Computer professionals, Subjective health status, Job dissatisfaction, Intentions to leave

## Introduction

The rapid spread of information technology (IT) has resulted in an increase in the number of computer professionals and development of new occupations (e.g., system engineers for mobile phones and web pages, etc.)[1, 2]. The nature of the IT service industry, a key industry in Japan is particularly known to lead to work-related stressors: technological changes, the diversification of manpower, and the reform of employment practices (i.e., performance-based evaluation system)[1, 2].

The IT industry is also known to be stressed with greater levels of work overload and job ambiguity[3–11]. Previous studies[3–10] concerning computer professionals (e.g., software engineers and technicians, etc.) have reported that various occupational health factors such as psychological distress and cumulative fatigue are caused by job-level stressors (e.g., quantitative and qualitative work overload). Furthermore, organizational factors (e.g., career development, rewards,

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and organizational structure) are related to psychological distress[5, 6, 10, 11].

Lo[9] reported that work environment stressors of computer professionals can be classified into two major groups: micro stressors and macro stressors. Micro stressors are classified as job-level factors (e.g., quantitative and qualitative work overload), and macro stressors are classified as organizational factors (e.g., career development, supervisor support, and management systems). Micro and macro stressors also affect computer professionals' health and productive behavior (e.g., turnover rate, job dissatisfaction, absenteeism, cost, etc.)[9], and that interactions between micro and macro stressors can potentially reduce organizational effectiveness[9, 10].

Although traditionally, in workplaces in Japan, rate of employee turnover has been low because of the typical management system, the computer industry is known to have a high rate of employee turnover[1, 2, 12, 13]. A previous report[2] indicated that 58% of IT engineers had a job change experience and half of them got a job in the same field. Since a high turnover of computer professionals is costly to organizations in terms of recruitment, replacement, and training expenses, as well as productivity[14–16], IT industry employers, in Japan, need to intervene with a better understanding of factors leading to employee resignation.

Previous studies of computer professionals reported the importance of career development, role ambiguity, and supervisor support concerning the intentions to leave and job satisfaction of employees[14, 16–18]. Thus, with a better understanding of micro and macro stressors, employers in the IT industry need a more effective strategy of human resource management, which minimizes computer professionals' occupational health problems and maximizes organizational effectiveness (i.e., reduced turnover).

In Japan, however, there has been only few researches[12, 19, 20] that examined the effect of micro and macro stressors on the subjective health status and productive behavior of computer professionals, and they had some limitations. Although the two studies[12, 20] found that "quantitative and qualitative job-overload" and "organizational characteristics" were important predictors of individual and organizational outcomes, the findings might not generalize workplaces with different demographics since they focused on technical support staff. Another study[19] focusing on various kinds of computer professionals (e.g., system engineers for mobile phones and web pages, etc.) found the predictors of micro and macro stressors on psychological distress and intentions to leave. However, since the outcomes focused on psychological distress and intentions to leave, the findings concerning physical and psychological well-being of employees and the effectiveness were limited. Therefore, further studies, which examine not only psychological distress and intentions to leave but also other subjective measures associated with physical and psychological well-being of employees and the effectiveness of organization (physical health and job dissatisfaction)[21], are needed.

Thus, in this study, we conducted an investigation to examine the effect of micro and macro stressors in the work environment on computer professionals' subjective health status (psychological distress and cumulative fatigue sign) and productive behavior (job dissatisfaction and intentions to leave) in Japan. This will help employers to understand ways to improve both the organizational effectiveness and employees' well-being.

## Materials and Methods

*Subjects*

This study was performed with the cooperation of two union federations: one is composed of unions of IT employees, and the other is composed of unions of electricians and IT employees. In 58 unions among both federations we asked to co-operate, 53 unions agreed to co-operate in this research while five unions disagreed to co-operate because of scheduling conflict. The two federations are among the five largest union federations in Japan, and the individual unions varied in size from less than 50 to more than 10,000 employees. The total number of members of both union federations was more than 900,000. The male to female ratio of both federations was 8:2, and the average age range of members was in their thirties for both sexes. More than 50% of the union members had a university degree, more than 80% were engineers, and about 90% were regular employees.

*Data collection*

Since the unions included in our study varied in terms of size and organizational characteristics, we used the quota sampling which is one of the non-probability sampling using sampling indicators such as age. From May to June of 2003, 30 voluntary participants of each union (n=1,590 from 53 unions) were chosen according to two quota sampling indicators: sex and age, based on the composition of the union federations. Participants accessed our webpage, which had a self-administered questionnaire that was accessible by a password we provided them with. The data they entered were sent to our database automatically

while maintaining the security of the data. The questionnaire consisted of items concerning individual attributes (sex, age, marital status, educational level, and current clinical information), employment characteristics (type of employment, software engineer or not, office location, years of service at current company, years of service in current job, and the number of previous employers), working hour characteristics (the number of working hours per day, the frequency of night work per month, and the frequency of weekend work per month), and company size as independent variables. Turnover studies need to examine not only work stress but also the business condition (i.e., profitability of the organization) and personal characteristics[19]; therefore, the questionnaire also included the profitability of the organization (revenue, profit, the rate of hiring new graduates) and personal characteristics (i.e., Growth Need Strength (GNS)) as independent variables. Moreover, the questionnaire included scale items of micro and macro stressors (see section 3.1.), and four outcome scales: subjective health status (psychological distress and cumulative fatigue) and productive behavior (job dissatisfaction and intentions to leave).

The final response rate was 66% (n=1,049, from 53 unions) after eliminating 61 respondents for missing data. Since about 80% of the respondents were computer engineers, we chose to focus on analyzing data from the engineers' group separately. Concerning the remaining 20% data, most of the occupations were clerical staff and administrative staff. Therefore, the subjects of this study were exclusively engineers (n=871). Eighty three percent (n=718) were male, and the average age of male members was 32.5 (SD=5.5) and that of female members was 29.6 (SD=4.9). These data indicate that the demographic characteristics of our sample are quite similar to those of the two union federations' total population.

*Measures*

1) Micro and macro stressors scale

To assess work and organizational characteristics as micro and macro stressors, we used a novel 29-item perceived work and organizational characteristics (PWOC) scale, which demonstrated a high internal consistency and reliability in Japanese IT workers[12, 20]. The PWOC scale consisted of seven subscales concerning both micro and macro stressors, both of which are indicated as engineers' stressors[9]. Seven subscales of the 29-item PWOC scale were divided into two categories: micro stressors, related to individual work and workplace characteristics, (i.e., "poor coworker support", "insufficient office amenities", and "quantitative and qualitative work overload"), and macro stressors, related to organizational factors (i.e., "poor supervisor support", "insufficient evaluation system", "undeveloped management system", and "career and future ambiguity") using the conceptual model of a previous study[9]. Each item was evaluated by a two-point response scale: 0 (I do not agree.) or 1 (I agree.). The items with the "1: I agree." response were further scored by a Likert-type scale from 0 ("The stressor is not a burden.") to 2 ("The stressor is an extreme burden."). The responses "0: I do not agree." and "1: I agree, but the stressor is not a burden." were scored the same: "0: The stressor is not a burden." This scoring decision was based on the idea that the strain one experiences depends on the person's perception of stressors[22]. To control for individual differences in the perceived stressor burden, the mean PWOC scores of all items marked "I agree." were weighted into the PWOC.

2) Profitability of the organization

To determine the profitability of the organizations involved in this study, we used objective measures of productivity[2]. During the following year of our internet survey, we obtained objective data concerning the profitability of each company including revenue, profit, and the rates of hiring new graduates during the fiscal year. All of these independent variables are representative business indicators. Each item provided a binary measure: 1 (decreased compared to the previous fiscal year) or 0 (almost the same level compared to the previous fiscal year, or increased compared to the previous fiscal year). Although the correlation between data of revenue and profit was relatively high (r=0.65), this did not lead to multicollinearity, so we used both data sets.

3) Assessment of Growth Need Strength (GNS)

For assessing the participants' personal characteristics, we used the Growth Need Strength (GNS) scale developed by Hackman and Oldham[23], in which the accuracy of the Japanese translation was confirmed, and then further verified by translating it from Japanese back into English and then from English back into Japanese. Previous studies of computer professionals also confirmed the high internal consistency and reliability of the GNS[24].

The items measured require respondents to indicate the desirability of various work conditions in their present job, and were evaluated by a seven-point response scale. The higher the total score, the more Growth Need Strength participants have. The Cronbach Alpha coefficient in this study was 0.85.

4) Subjective health status

For assessing participants' subjective health status, we used scales for psychological distress and cumulative fatigue signs.

General Health Questionnaire (GHQ): Psychological distress was assessed with the Japanese version of the 12-item General Health Questionnaire (GHQ-12), which demonstrated high concurrent validity and internal consistency and reliability in Japanese workers[12, 20]. The GHQ items were scored by 0-1-2-3 Likert scoring in order to assess the impairment level. The higher the total score, the more psychological distress the participants have. The Cronbach alpha coefficient in this study was 0.78.

Cumulative Fatigue Symptom Index (CFSI): We assessed participants' cumulative fatigue signs using an 18-item version (CFSI-18) of the Cumulative Fatigue Symptom Index[25], which was developed from a 60-item index that measured symptoms related to cumulative fatigue with a high internal consistency and reliability in Japanese adults[26]. The 18-item version had been used in previous research on computer technical support staff in Japan, and a significant relationship was found between work stress and the CFSI subscales[12, 20]. Participants were asked whether they had recently experienced particular symptoms related to cumulative fatigue or not (e.g., "I have had eyestrain recently."). Measurement was performed by a two-point response scale. The higher the total score, the more cumulative fatigue symptoms the participants had. The Cronbach Alpha coefficient in this study was 0.87.

5) Productive behavior

For assessing participants' productive behavior, we used scales for job dissatisfaction and intentions to leave.

Assessment of job dissatisfaction: Job dissatisfaction was assessed by a Japanese translation[27] of a 15-item scale originally developed by Mclean[28], which demonstrated high internal consistency and reliability in Japanese workers[12, 20, 27]. The scale measures the degree of job satisfaction/dissatisfaction with regard to various working conditions, such as human relationships, remuneration, and so on. It employed a five-point Likert-type scale. The higher the total score, the more dissatisfaction the participants perceived. The Cronbach Alpha coefficient in this study was 0.87.

Assessment of intentions to leave: Intentions to leave were assessed by a 6-item scale developed by the chief author and a colleague, which used qualitative data and demonstrated a high internal consistency and reliability in Japanese IT workers[12, 20]. Each item asked about the subject's thoughts or behavior relating to resignation from their job ("I am fed up with my job at the present company and am earnestly gathering information to find a new job." etc.). Responses were scored with a four-point Likert-type scale. The higher the total score, the stronger the intentions to leave. The Cronbach Alpha coefficient in this study was 0.91.

*Data analyses*

We calculated descriptive statistics and correlation coefficients of micro and macro stressors subscales and four dependent variables. Next, hierarchical multiple regression analysis for the four dependent variables (GHQ-12, CFSI-18, "job dissatisfaction", and "intentions to leave") was performed to attempt to determine macro and micro stressors affecting participants' subjective health status and productive behavior.

Concerning subjective health status outcomes (GHQ-12 and CFSI-18), in model 1, analysis was performed on each independent variable controlling for data of profitability and variables of personal characteristics (GNS) as well as demographic variables (sex, age, marital status, educational level, and current clinical information), employment characteristics (type of employment, software engineer or not, office location, and the number of previous employers), working hour characteristics (the number of working hours per day, the frequency of night work per month, and the frequency of weekend work per month), company size, and the profitability of the organization (revenue, profit and the rate of hiring new graduates). In model 2, three micro stressors ("poor coworker support", "insufficient office amenities", and "quantitative and qualitative work overload") were entered into the equations as independent variables. Finally, four macro-stressors variables ("poor supervisor support", "insufficient evaluation system", "undeveloped management system", and "career and future ambiguity") were entered into the equations as independent variables in model 3.

According to Mobley[16], although the lower the job satisfaction is the greater the probability of turnover, turnover researches need to use variables other than job satisfaction to predict individual-level turnover since the use of overall satisfaction offers little diagnostic value regarding what aspects of the job are contributing to turnover. Thus, in our research, job dissatisfaction was not included in the equations of intentions to leave as independent variables.

Concerning model 1 of "job dissatisfaction" and "intentions to leave", in addition to the equations of health status (Model 1), the GHQ-12 and CFSI-18 variables were also entered as independent variables to control the effect of subjective health status. Next, three micro-stressors

variables were entered into the equations as independent variables (model 2). Finally, four macro stressor variables were entered into the equations as independent variables (model 3). The statistics package used was SPSS11.0J.

## Results

Table 1 shows a summary of the participants' basic attributes and employment characteristics. Ninety three% were regular employees and 37% of the participants worked at mid-size companies (companies with 201-1,000 employees). About 9% indicated that they had worked for at least one other employer in the past. Concerning profitability, 50% of the companies had a lower revenue compared to the previous year, and 40% had a reduced profit compared to the previous year. Although not shown in the table, 62% of the participants were software engineers, and 28% were engineers whose job was related to an internet provider or to cell phones or computer technical support. Twenty five% had two or more jobs at the same time in the same office (i.e., software engineer and manager). More than 90% worked in non-management positions.

Table 2 showed the Cronbach Alphas and correlation coefficients of seven subscales of micro and macro stressors, Growth Need Strength and four dependent variables. The correlation of each variable of micro stressor subscales was r=0.24–0.35, and that of each macro stressor subscales was r=0.10–0.53.

Table 3 shows the results of the hierarchical multiple regression analysis of two subjective health status variables (GHQ-12 and CFSI-18). The dependent variable GHQ-12 explained 4%, 18%, and 23% of variance, and CFSI-18 explained 5%, 18%, and 20% of variance of each model, respectively.

The GHQ-12 scores (model 1) were significantly higher in single people, and those who worked longer hours. When variables of micro stressors of PWOC subscales were added (model 2), "poor coworker support" and "quantitative and qualitative work overload" became significant. Also, the GNS was found to be significant and the beta values were negative. When variables of macro stressors of subscales were added (model 3), all variables except for "poor supervisor support" were found to be significant.

As with GHQ-12, the CFSI-18 score (model 1) was significantly higher in women, single people, in people with an illness, and those who worked longer hours. When variables of micro stressor subscales were added (model 2), all variables were found to be significant. When variables of macro stressor subscales were added (model 3), "undeveloped management systems" and "career and future ambiguity" were found to be significant, while the significance of "poor coworker support", "insufficient office amenities", and working longer hours disappeared.

Table 4 shows the results of the hierarchical multiple regression analysis of "job dissatisfaction" and "intentions to leave". The dependent variable of "job dissatisfaction" explained 22%, 29%, and 44% of the variance, and "intentions to leave" explained 27%, 31%, and 35% of variance of each model, respectively.

"Job dissatisfaction" (model 1) was significantly higher in software engineers, those who worked all night more often, and those who worked for a company where profits had increased from the previous year. Both health status variables (GHQ-12 and CFSI-18) were also found to be significant. When variables of micro stressor subscales were added (model 2), all were found to be significant, while the significance of occupation and working hour characteristics disappeared. When variables of macro stressor subscales were added (model 3), all were found to be significant, while the significance of profit, health status variables (CFSI-18), "quantitative and qualitative work overload", and "poor coworker support" disappeared.

The "intentions to leave" scores (model 1) were significantly higher in women, those who worked all night more often, those who worked for companies with a decreased revenue, and companies with an increased profit compared to the previous year. Both health status variables (GHQ-12 and CFSI-18) were also found to be significant. When variables of micro stressor subscales were added (model 2), "quantitative and qualitative work overload" were found to be significant, while the significance of frequency of night work disappeared. When variables of macro stressor subscales were added (model 3), "poor supervisor support" and "insufficient evaluation systems" were found to be significant, while the significance of company revenue disappeared. Also, the significance of sex and age were found to be significant.

## Discussion

*Subjective health status of computer professionals*

Quantitative and qualitative work overload was the most important predictor of both psychological distress and cumulative fatigue symptoms as the subjective health status variables. These results supported those of previous studies of software engineers[4–7, 10]. Among the macro stressors, career development and future ambiguity were the most important predictors of both subjective health status variables.

**Table 1. Demographic characteristics of the sample (N=871)**

| | Variables | N | % |
|---|---|---|---|
| A. Sex | Male | 718 | 83% |
| | Female | 148 | 17% |
| B. Age | 20–29 | 300 | 35% |
| | 30–39 | 482 | 55% |
| | Over 39 | 85 | 10% |
| C. Marital status | Single | 456 | 53% |
| | Married | 413 | 47% |
| D. Education | Junior high school graduate | 0 | 0% |
| | High school equivalency degree | 92 | 10% |
| | Junior college or vocational school equivalency degree | 176 | 19% |
| | College graduate | 502 | 59% |
| | Graduate degree or higher | 101 | 12% |
| E. Presence of illness | Yes | 105 | 12% |
| | No | 766 | 88% |
| F. Type of employment | Permanent employee | 812 | 93% |
| | Contracted employee | 59 | 7% |
| G. Type of job | Software engineer | 542 | 62% |
| | Non software engineer | 329 | 38% |
| H. Business establishment | 1–200 | 281 | 32% |
| | 201–1,000 | 318 | 37% |
| | 1,001– | 271 | 31% |
| I. Number of previous employers | None | 781 | 90% |
| | One or two | 83 | 9% |
| | Three or more | 8 | 1% |
| J. Working hours | 7 h or less | 15 | 2% |
| | 8 h | 185 | 21% |
| | 9 h | 289 | 33% |
| | 10 h | 238 | 28% |
| | More than 10 h | 142 | 1% |

| K. Frequency of overtime | Night work | | Weekend work | |
|---|---|---|---|---|
| Never | 557 | 64% | 360 | 41% |
| 1 or 2 d/month | 217 | 25% | 363 | 42% |
| 3 or 4 d/month | 38 | 4% | 101 | 12% |
| More than 5 d/month | 54 | 6% | 44 | 5% |

| L. Years of service | In current job (ITprofessional) | In current organization |
|---|---|---|
| Mean | 6.2 | 9.4 |
| SD | 4.9 | 5.7 |

| M. Profitability[1)] | Revenue | Profit | Hiring new graduates |
|---|---|---|---|
| Decreased compared to last year | 349 (50%) | 275 (40%) | 284(41%) |
| Same or increased | 345 (50%) | 419 (60%) | 410 (59%) |

[1)]: Each profitabilities' item was provided a binary measure: 1 (decreased compared to last fiscal year) or 0 (almost the same level compared to last fiscal year, or increase compared to last fiscal year).

**Table 2. Cronbach alphas and correlation coefficients of perceived work and organizational characteristics, growth need strength and dependent variables (N=871)**

| Perceived work and organizational characteristics | N | Mean | SD | Items | Range | Cronbach Alphas | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (1) Poor coworker support | 868 | 0.51 | 1.12 | 3 | 0–6 | 0.74 | 1.00 | | | | | | | | | | | |
| (2) Insufficient office amenities | 868 | 1.69 | 1.90 | 3 | 0–6 | 0.77 | 0.24*** | 1.00 | | | | | | | | | | |
| (3) High job demands and low control | 868 | 3.41 | 3.62 | 8 | 0–16 | 0.84 | 0.30*** | 0.35*** | 1.00 | | | | | | | | | |
| (4) Poor supervisor support | 868 | 0.95 | 1.64 | 3 | 0–6 | 0.86 | 0.39*** | 0.29*** | 0.25*** | 1.00 | | | | | | | | |
| (5) Insufficient evaluation systems | 868 | 2.57 | 2.39 | 4 | 0–8 | 0.85 | 0.25*** | 0.28*** | 0.27*** | 0.40*** | 1.00 | | | | | | | |
| (6) Undeveloped management systems | 868 | 2.16 | 2.03 | 4 | 0–8 | 0.66 | 0.36*** | 0.43*** | 0.56*** | 0.56*** | 0.44*** | 1.00 | | | | | | |
| (7) Career and future ambiguity | 868 | 2.95 | 2.39 | 4 | 0–8 | 0.76 | 0.31*** | 0.40*** | 0.41*** | 0.35*** | 0.48*** | 0.53*** | 1.00 | | | | | |
| (8) GNS[1)] | 865 | 22.71 | 7.58 | 5 | 5–35 | 0.85 | 0.08* | 0.08* | –0.01 | 0.10** | 0.12*** | 0.10** | 0.11** | 1.00 | | | | |
| (9) GHQ-12 | 871 | 15.89 | 5.89 | 12 | 0–36 | 0.87 | 0.22*** | 0.19*** | 0.39*** | 0.21*** | 0.10** | 0.35*** | 0.31*** | –0.07 | 1.00 | | | |
| (10) CFSI-18 | 868 | 25.86 | 4.55 | 18 | 18–36 | 0.85 | 0.20*** | 0.26*** | 0.37*** | 0.22*** | 0.18*** | 0.34*** | 0.32*** | –0.04 | 0.67*** | 1.00 | | |
| (11) Job dissatisfaction | 871 | 45.13 | 10.70 | 15 | 15–75 | 0.89 | 0.33*** | 0.38*** | 0.39*** | 0.44*** | 0.48*** | 0.53*** | 0.06*** | 0.39*** | 0.57*** | 0.39*** | | |
| (12) Intentions to leave | 871 | 13.36 | 4.91 | 6 | 6–24 | 0.89 | 0.22*** | 0.28*** | 0.41*** | 0.30*** | 0.30*** | 0.44*** | 0.45*** | 0.01 | 0.47*** | 0.46*** | 0.57*** | 1.00 |

Symbols indicate level of significance: *<0.05; **<0.01; ***<0.001. [1)]: Growth need strength.

These results suggest that career development and future ambiguity are important not only in turnover but also in the subjective health status of each individual, expanding knowledge concerning the career development of computer professionals[9, 20)].

Previous studies of computer professionals have shown turnover resulting from anxiety about demands for the latest knowledge/techniques due to rapid technological innovation and limitations in career development under the acceleration of technological innovation[2, 29)]. These career developmental problems may affect both physical and psychological health of computer professionals[9, 12, 20)]. Therefore, health management measures for computer professionals should include technical education corresponding to the accelerating technological innovation, provision of opportunities of personnel training with consideration given to various career paths such as management and related departments, and the announcement of a policy of medium- to long-term career development.

On the other hand, cumulative fatigue symptoms were marked in the presence of illness, while psychological stress was marked when Growth Need Strength as a personal characteristic was low, evaluation systems were insufficient, and coworker support was poor. Thus, matters associated with self-motivation may markedly affect psychological stress. Concerning interventions for health problems in computer professionals, it is important to understand differences between the factors affecting the mind or body, and take appropriate measures. In this study, poor supervisor support that was indicated as an important predictor in previous studies[18, 20)] was not associated with the subjective health status. However, since this factor is also associated with self-motivation[30)], further studies are necessary to evaluate its association with the subjective health status.

*Job dissatisfaction and intentions to leave in computer professionals*

Quantitative and qualitative work overload was the most important predictor of intentions to leave. Among the macro stressors, insufficient evaluation systems and poor support by supervisors who perform evaluation were important factors associated with job dissatisfaction and intentions to leave. Therefore, when computer professionals have negative feelings toward systems, in which their work ability and vocational aptitude should be fairly evaluated and reflected by pay and positions, they may be dissatisfied with the job and have intentions to leave.

Traditionally, in workplaces in Japan, management has been performed using the lifetime employment system and the seniority system in which age and the duration of service are the most important criteria[31)]. On the other hand, the IT

**Table 3. The results of hierarchial multiple regression analysis for GHQ-12 and CFSI-18 (N=670)**

| | GHQ-12 | | | CFSI-18 | | |
|---|---|---|---|---|---|---|
| | Model 1 | Model 2 | Model 3 | Model 1 | Model 2 | Model 3 |
| | B | B | B | B | B | B |
| Individual attributes | | | | | | |
| Sex[1)] | 0.0803 | 0.0615 | 0.0653 | 0.1110** | 0.0920* | 0.0959* |
| Age | 0.0117 | –0.0288 | –0.0128 | 0.0064 | –0.0277 | –0.0225 |
| Marital status[2)] | 0.1146** | 0.1003* | 0.0915* | 0.1146** | 0.0945* | 0.0901* |
| Education[3)] | –0.0134 | 0.0034 | –0.0073 | –0.0340 | –0.0088 | –0.0167 |
| Presence of illness[4)] | 0.0561 | 0.0306 | 0.0275 | 0.1298** | 0.1034** | 0.0979** |
| Employment characteristics | | | | | | |
| Type of employment[5)] | 0.0225 | 0.0354 | 0.0453 | –0.0330 | –0.0146 | –0.0090 |
| Software engineer | 0.0386 | 0.0106 | 0.0094 | 0.0291 | 0.0007 | 0.0007 |
| Office location[6)] | 0.0308 | 0.0195 | –0.0039 | 0.0441 | 0.0378 | 0.0180 |
| Number of previous employers[7)] | 0.0353 | 0.0498 | 0.0542 | 0.0513 | 0.0607 | 0.0684 |
| Working hour characteristics | | | | | | |
| Working hours[8)] | 0.1034* | 0.0019 | –0.0058 | 0.0974* | –0.0044 | –0.0111 |
| Frequency of night work[9)] | 0.0184 | –0.0391 | –0.0342 | 0.0605 | 0.0123 | 0.0162 |
| Frequency of weekend work[10)] | 0.0744 | 0.0476 | 0.0558 | 0.0221 | –0.0082 | 0.0004 |
| Company size[11)] | | | | | | |
| Small | 0.0477 | 0.0148 | 0.0047 | 0.0073 | –0.0240 | –0.0351 |
| Middle | 0.0890 | 0.0279 | 0.0326 | 0.0886 | 0.0291 | 0.0299 |
| Profitability[12)] | | | | | | |
| Revenue | –0.0499 | –0.0812 | –0.0895 | 0.0116 | –0.0235 | –0.0294 |
| Profit | –0.0163 | 0.0024 | 0.0154 | –0.0378 | –0.0202 | –0.0075 |
| The rates of hiring new graduates | 0.0247 | 0.0222 | 0.0153 | –0.0075 | –0.0124 | –0.0193 |
| GNS | –0.0685 | –0.1072** | –0.1172** | –0.0090 | –0.0510 | –0.0681 |
| Perceived work and Organizational characteristics | | | | | | |
| Micro- stressors | | | | | | |
| Poor coworker support | | 0.1573*** | 0.1006* | | 0.0878* | 0.0326 |
| Insufficient office amenities | | 0.0389 | –0.0026 | | 0.1162** | 0.0707 |
| Quantitative and qualitative work overload | | 0.3344*** | 0.2564*** | | 0.3150*** | 0.2354*** |
| Macro- stressors | | | | | | |
| Poor supervisor support | | | 0.0596 | | | 0.0608 |
| Insufficient evaluation systems | | | –0.1446*** | | | –0.0350 |
| Undeveloped management systems | | | 0.1375** | | | 0.1144* |
| Career and future ambiguity | | | 0.1716*** | | | 0.1266** |
| Adjusted $R^2$ | 0.0364 | 0.1812 | 0.2259 | 0.0494 | 0.1796 | 0.2061 |

Symbols indicate level of significance: *<0.05; **< 0.01; ***<0.001. [1)]: 0=Male; 1=Female. [2)]: 0=Currently married; 1=Single. [3)]: 1=College graduate or graduate degree or higher; 0=Others. [4)]: 1=Yes, 0=No. [5)]: 0=Permanent employees; 1=Others. [6)]: 1=At their own office; 1=Others. [7)]: 1=Less than 1 yr –5=More than 5 yr. [8)]: 1=Less than 7 h –5=More than 10 h. [9)]: 1=None–4=More than 5 d/month. [10)]: 1=None–4=More than 5 d/month. [11)]: 1=Yes, 0=No. [12)]: 1=Decreased compared to last fiscal year; 0=Others.

industry was one of the pioneering industries to use the result-based pay system in Japan[1, 2)]. The introduction of result-oriented management has caused severe competition, escalating long work hours, increased workers' own responsibility, enhanced anxiety, and influences on psychological health[32)]. In particular, in the IT industry, computer professionals are required to develop their careers by constantly acquiring the latest knowledge and techniques[5, 17)]. Therefore, when they can not expect a fair evaluation, their level of job dissatisfaction and intentions to leave may increase. Thus, in organizations, measures for career development and supervisor support are necessary to reduce job dissatisfaction and any intentions to leave and improve morale and productivity[9, 16–18, 30)].

Although the profitability of the organization and chronic fatigue were associated with intentions to leave, in this study, these variables were not associated with job dissatisfaction. In addition, macro stressors such as evaluation systems were

**Table 4. The results of hierarchial multiple regression analysis for job dissatisfaction and intentions to leave (N=670)**

| | Job dissatisfaction | | | Intentions to leave | | |
|---|---|---|---|---|---|---|
| | Model 1 | Model 2 | Model 3 | Model 1 | Model 2 | Model 3 |
| | B | B | B | B | B | B |
| Individual attributes | | | | | | |
| Sex[1)] | –0.0628 | –0.0705* | –0.0587 | 0.0595 | 0.0603 | 0.0676* |
| Age | 0.0615 | 0.0404 | 0.0141 | –0.0532 | –0.0741 | –0.0870* |
| Marital status[2)] | –0.0158 | –0.0036 | 0.0066 | 0.0045 | 0.0020 | 0.0076 |
| Education[3)] | –0.0033 | 0.0174 | 0.0123 | 0.0503 | 0.0621 | 0.0609 |
| Presence of illness[4)] | –0.0308 | –0.0402 | –0.0513 | 0.0455 | 0.0396 | 0.0333 |
| Employment characteristics | | | | | | |
| Type of employment[5)] | –0.0587 | –0.0450 | –0.0477 | 0.0225 | 0.0329 | 0.0334 |
| Software engineer | 0.0734* | 0.0647 | 0.0671* | –0.0323 | –0.0458 | –0.0481 |
| Office location[6)] | 0.0406 | 0.0396 | 0.0146 | 0.0103 | 0.0114 | -0.0021 |
| Number of previous employers[7)] | –0.0465 | –0.0314 | –0.0059 | 0.0316 | 0.0418 | 0.0558 |
| Working hour characteristics | | | | | | |
| Working hours[8)] | 0.0250 | –0.0077 | –0.0183 | 0.0155 | –0.0436 | –0.0495 |
| Frequency of night work[9)] | 0.0843* | 0.0698 | 0.0757* | 0.0983* | 0.0668 | 0.0702 |
| Frequency of weekend work[10)] | –0.0266 | –0.0410 | –0.0248 | –0.0383 | –0.0531 | –0.0417 |
| Company size[11)] | | | | | | |
| Small | 0.0470 | 0.0396 | 0.0156 | 0.0145 | 0.0213 | 0.0035 |
| Middle | 0.0534 | 0.0261 | 0.0185 | 0.0673 | 0.0368 | 0.0329 |
| Profitability[12)] | | | | | | |
| Revenue | 0.0734 | 0.0461 | 0.0404 | 0.1192* | 0.0929* | 0.0888 |
| Profit | –0.1173* | –0.0993* | –0.0763 | –0.1404** | –0.1318** | –0.1197** |
| The rates of hiring new graduates | 0.0163 | 0.0051 | –0.0085 | 0.0484 | 0.0465 | 0.0402 |
| GNS | 0.0965** | 0.0412 | –0.0143 | 0.0346 | 0.0074 | –0.0219 |
| GHQ-12 | 0.3186*** | 0.2588*** | 0.2664*** | 0.2492*** | 0.1945*** | 0.1648*** |
| CFSI-18 | 0.1664*** | 0.1070* | 0.0480 | 0.2753*** | 0.2157*** | 0.2174*** |
| Perceived work and Organizational characteristics | | | | | | |
| Micro- stressors | | | | | | |
| Poor coworker support | | 0.1534*** | 0.0552 | | 0.0440 | –0.0073 |
| Insufficient office amenities | | 0.1693*** | 0.0822* | | 0.0590 | 0.0128 |
| Quantitative and qualitative work overload | | 0.1060* | –0.0232 | | 0.2309*** | 0.1672*** |
| Macro- stressors | | | | | | |
| Poor supervisor support | | | 0.1447*** | | | 0.0799* |
| Insufficient evaluation systems | | | 0.2640*** | | | 0.1277*** |
| Undeveloped management systems | | | 0.1264** | | | 0.0472 |
| Career and future ambiguity | | | 0.0835* | | | 0.0651 |
| Adjusted $R^2$ | 0.2243 | 0.2947 | 0.4392 | 0.2686 | 0.3148 | 0.3493 |

Symbols indicate level of significance: *<0.05; **<0.01; ***<0.001. [1)]: 0=Male; 1=Female. [2)]: 0=Currently married; 1=Single. [3)]: 1=College graduate or graduate degree or higher; 0=Others. [4)]: 1=Yes, 0=No. [5)]: 0=Permanent employees; 1=Others. [6)]: 1=At their own office; 1=Others. [7)]: 1=Less than 1 yr –5=More than 5 yr. [8)]: 1=Less than 7 h –5=More than 10 h. [9)]: 1=None –4=More than 5 d/month. [10)]: 1=None –4=More than 5 d/month. [11)]: 1=Yes, 0=No. [12)]: 1=Decreased compared to last fiscal year; 0=Others.

more important predictors of job dissatisfaction in computer professionals, rather than quantitative and qualitative work overload. According to previous studies[16, 33)], strong intentions to leave have been suggested to be associated with job dissatisfaction and a negative view of the workplace and work. However, the results of this study suggested differences in factors between job dissatisfaction and intentions to leave. Our findings suggest that the important factors associated with intentions to leave included not only organizational problems but also wide-ranging items such as the job itself, workers' health status, and the profitability of the organization.

Concerning the association between intentions to leave and the profitability of the organization, a previous study[16, 33)] suggested that an increase in a company's profit enhances the value of its workers in the labor market, and makes them

feel more worthy professionals in an external employment market. This situation makes them recognize more advantages in other areas of the labor market, and promotes intentions to leave.

In addition, the turnover rate varies among industries, nations, or districts, and is affected by not only the economical situation in Japan, but also by Japanese culture[34]. Therefore, intentions to leave and job dissatisfaction in computer professionals should be further evaluated in association with the economical situation and Japanese culture in addition to macro and micro stressors.

*Influences of micro and macro stressors in work environments on computer professionals*

In Japan, in computer professionals including not only software engineers but also new occupations (such as system engineers for mobile phones and web pages), measures against micro stressors, particularly quantitative and qualitative work overload, may be important not only in improving the health of each individual, but also lessening any intentions to leave.

In addition, the results that beta score of the respective micro stressor variables decreased in model 3 in each outcome (see Tables 3 and 4) leads us to speculate on how organizations might reduce macro and micro stressors for IT professionals. In computer professionals in the IT industry, organizational problems such as evaluation systems and management systems may affect quantitative and qualitative work and work environmental problems, resulting in influences on the subjective health status, job dissatisfaction, and intentions to leave. This supports the suggestion by previous studies that the short history of the IT industry and immature organizational characteristics derived from technological innovation are present in the background of quantitative and qualitative work overload[3, 5]. This also suggests that an organization must have consistent structure, policies, and procedures to be profitable, competitive, and to promote employees' health.

Furthermore, the results of this study support the concept of "organizational health", that "organizational characteristics (such as management practices, organizational culture/climate, and organizational values)" are important factors affecting "organizational health" such as workers' health/satisfaction and performance, and measures with consideration for "organizational health" bring profits to both workers and companies[21].

Since individual labor in the organization is present in the work process as the frame of the organization, interventions in macro stressors as organizational factors require time due to difficulty in coping with each worker and the involvement of various factors. Therefore, medium- to long-term measures are necessary with consideration for the degree of difficulty in and the order of priority of interventions concerning each factor, such as career development and supervisor support.

*Limitations of this study and future directions*

This study has some limitations. First, as participants were recruited with the quota sampling, using two union federations, problems unique to those federation members may be reflected in the results. In addition, our findings might have non-response bias considering 34% non-response participants and six unions disagreed to co-operate our research. In the future, it would be useful to conduct a large scale survey including people who are not federation members. Also, the reliability and validity of scales for micro and macro stressors and intentions to leave, which had been developed by the authors, would benefit from further testing in the future. Another limitation is that because this study was cross-sectional, it cannot detect causal relationships. To establish such causal links, it will be necessary to conduct longitudinal surveys in the future. In addition, because almost all participants were regular employees, and relatively well-educated (about 70% had bachelor's degrees or higher), the results presented here might not be applicable to workplaces with different demographics. Finally, since all dependent variables were based on self-reported data, further studies using more objective measures would be helpful.

On the other hand, our study had high coefficients of determination (adjusted R squared), especially for "job dissatisfaction" and "intentions to leave" (See Table 4). Also, little research has been done to examine the effect of micro and macro stressors on IT workers' subjective measures which associated with physical and psychological well-being of employees and the effectiveness of organization, including workers whose job is related to the web or cell phones in Japan. This study also shows that both objective data (i.e., profitability) and personal data (i.e., GNS) can be used in the field of occupational stress in Japan.

Therefore, although our findings may have some limitations, our approach has yielded meaningful insights into not only the IT service industry, but also into other domestic industries with similar organizational characteristics. Since occupational stress is costly in terms of organizational outcomes, research on occupational stress has implications for organizational effectiveness. Further research measuring subjective health status and productive

behavior both within and beyond the Japanese IT industry would be useful.

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**Apendix.** Result of score of perceived work and organizational characteristics (N=871)

| Items | Mean | SD |
|---|---|---|
| Micro-stressors | | |
| Poor coworker support | | |
| When I am in trouble at work, my colleagues do not help me with technology and practical work. | 0.23 | 0.53 |
| I do not have colleagues who listen to my grumbling about work and talk to me. | 0.17 | 0.45 |
| I could hardly say my colleagues are capable. | 0.12 | 0.41 |
| Insufficient office amenities | | |
| The rest space in the office is uncomfortable. | 0.59 | 0.78 |
| The office layout and crowding are uncomfortable. | 0.53 | 0.76 |
| The office room temperature and humidity are uncomfortable. | 0.59 | 0.77 |
| High job demands and low control | | |
| My work is very hectic. | 0.58 | 0.75 |
| In my work, I receive many complaints from customers or work partners. | 0.46 | 0.69 |
| I am required to work very fast. | 0.42 | 0.65 |
| I have to do a lot of work with much unexpected overtime work. | 0.62 | 0.76 |
| Neither rest nor lunchtime can be taken as scheduled. | 0.25 | 0.56 |
| My work requires detailed work and searches for information. | 0.41 | 0.63 |
| My work requires new technology and knowledge every day. | 0.44 | 0.68 |
| I am under time pressure constantly. | 0.17 | 0.45 |
| Macro-stressors | | |
| Poor supervisor support | | |
| When I am in trouble at work, my supervisors do not help me with technology and/or and practical work. | 0.32 | 0.62 |
| When I am in trouble at work, my supervisors hardly ever give me advice or talk to me. | 0.29 | 0.58 |
| I could hardly say my supervisors are capable. | 0.34 | 0.64 |
| Insufficient evaluation systems | | |
| The merit system does not reflect my actual capability. | 0.59 | 0.69 |
| How remuneration and promotion are decided is unclear. | 0.78 | 0.77 |
| I often disagree with the result of my evaluation. | 0.60 | 0.71 |
| Workers' sociality and humanity are ignored in this company. | 0.61 | 0.75 |
| Undeveloped management systems | | |
| The command structure is not unified in our workplace. | 0.61 | 0.76 |
| Organizational transparency is low in our workplace. | 0.54 | 0.72 |
| In our workplace, cooperative structures are poor. | 0.58 | 0.75 |
| We do not have enough communication in our workplace. | 0.42 | 0.65 |
| Career and future ambiguity | | |
| I cannot imagine myself working for this company three years from now. | 0.71 | 0.78 |
| In this company, there are few types of job to which we can be moved. | 0.59 | 0.76 |
| The future of this company is doubtful. | 1.05 | 0.82 |
| Educational opportunities to develop technology and ability are not available in this company. | 0.59 | 0.76 |

1): Answers indicating workers' stress were weighted on a scale from 0 to 2.