Impacts of Overtime Reduction on Psychological Well-Being for Japanese Research and Development Engineers: Positive and Negative Sides of Work Time Regulations

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Abstract

In recent years, Japanese employers increasingly impose restrictions on employees' work time. Reduced overtime work has impacted a large number of engineers employed in private firms, making it more difficult to put in extra hours to complete their work. As a result, the incidences of experiencing incompletion and non-accomplishment in work have grown among Japanese engineers. This study investigates whether and how the overtime reduction affects engineers' work experiences and their psychological well-being. Results show that intensification in overtime reduction negatively affects engineers' work experiences regardless of their managerial status. It increases their job demands and unfinished work, while it reduces their workplace communication. Furthermore, overtime reduction is likely to deteriorate engineers' psychological well-being. Reduced overtime exhibited negative indirect influence on their work engagement and mental health via increased demands and reduced communication. Findings suggest that managing overtime work is an important aspect of human resource management of engineers, and it is imperative that we recognize immoderate work time regulations may bring about unintended negative consequences in engineers' work.

Keywords

overtime reduction, engineers, work engagement, depression, Japan

(1) Introduction

Long hours of work have been regarded for many years as an important characteristic of Japanese work lives (cf. Kuroda & Yamamoto, 2012; Ogura, 2007). It is officially reported that the annual work hours in Japan between 1999 and 2009 were over 1800 hours, and that the average annual hours worked exceeded 2,000 hours[1] in several years during this period (See Table1; Ministry of Health, Labour and Welfare, 2011). Full-time employees in Japan worked approximately 2000 hours per year, and this was 400 hours longer than the hours their counterparts in Germany and France worked (The Japan News, 2012).

Japanese employers, however, started to cut back on the hours of employees' overtime work soon after the financial crisis hit the economy in 2008 (See Table 1). Employer's restriction of overtime work has impacted a large number of R&D engineers employed in private firms, making it increasingly difficult for them to put in extra hours in work. As a result, the incidences of experiencing incompletion and non-accomplishment in work grew among Japanese engineers.

Japan is an island country with limited natural resources, so that innovative, technological contributions that R&D engineers make are a crucial requisite for Japan's economic development. In order to elicit their continued contributions, it is important to look carefully at R&D engineers' work conditions.

Up till today, a limited number of studies have explored the psychological experiences of R&D engineers in Japan. Fujimoto and Nakata (2007) reported that Japanese engineers' motivation had declined between 1994 and 2005. They found that the negative effect of dissatisfaction with HRM on work motivation had become exacerbated during the 9 years between 1994 and 2005. Such results imply that Japanese R&D engineers' psychological well-being may have deteriorated during the past two decades. Psychological well-being is conceptualized as a combination of positive affective states such as happiness (the hedonic element) and functioning with optimal effectiveness in individual and social life (the eudaimonic element) (Deci & Ryan, 2008). Huppert (2009) claims that psychological well-being is about lives going well, and it is the combination of feeling good and functioning effectively. Based on Schaufeli & Bakker (2004), we view engagement in work and mental health as two important factors of psychological well-being. While we believe that "living well" is important to all people regardless of occupations, it is highly likely that well-being is an important psychological resource which enables R&D engineers' creative performance at work. Yet, only a limited attention has been paid to this day to the Japanese R&D engineers' psychological well-being in relation to the circumstances of their employment.

The purpose of this study is to investigate how the intensified reduction of overtime work in Japanese firms after the financial crisis in 2008 affected R&D engineers' work experiences and their psychological well-being. Specifically, we address the following research questions: (1) Does reduction in overtime work increase Japanese engineers' job demands and decrease their workplace communication? If so, does it exert stronger impacts on managerial engineers than on non-managerial engineers? (2) Does overtime reduction deteriorate engineers' work engagement and mental health? If so, does it exert an indirect influence on them via increased job demands and decreased

[1] The average annual hours of work between 2002 and 2007 exceeded 2000 hours. In 2007, the average reached 2033 hours.

communication, or does it exert direct impacts on them?

This paper is organized in the following order. First, we overview the situations surrounding engineers' work in Japan, and we briefly review our theoretical framework and analytic model. Then, we provide details of our method and report the results of statistical analysis. Finally, we discuss our findings and conclude this paper by indicating the direction for future research.

Table 1. Changes in Annual Work Hours between 1999 and 2009

Year	Average of Official Work Hours	Average of Actual Work Hours	Average of Overtime Work Hours
1999	1834	1990	156
2000	1835	1999	164
2001	1835	1990	155
2002	1836	2000	164
2003	1843	2016	173
2004	1836	2015	179
2005	1832	2012	180
2006	1837	2024	187
2007	1841	2033	192
2008	1820	1996	176
2009	1807	1972	165

Source: Ministry of Health, Labour and Welfare (2011)

Note: The survey was conducted among full-time employees in Japan.

(2) Backgrounds

1. Work Hours in Japan

In Japan, the importance of work-life balance is increasingly recognized by employers and employees, as well as the government. Most of the past research on work-life balance evolved around the key issue of how to reduce long hours of work in order to ensure sufficient time for private life. Needless to say, regulating long hours of work is important to improve workers' well-being. In this sense, it is probably true that overtime restriction in and of itself is a blessing for a majority of Japanese workers.

A cross-national comparison of the average annual hours actually worked by employees shows that Japan is not the only country with long hours of work, but workers in Japan, U.S. and Korea work equally long hours[2] (Japan Institute for Labour Policy and Training [JILPT], 2013)[3]. In addition, the proportion of employees who work more than 60 hours per week is over 10 percent in Japan (Ministry of Internal Affairs and Communications, 2013), and the proportion of those who put in long hours of work is not only larger compared with other industrialized nations but is also as large as in other developing countries (Ogura, 2008). The average annual hours of overtime for Japanese workers between 2006 and 2008 (before the financial crisis) exceeded 180 hours.

[2] This comparison included both full-time and part-time workers.

[3] Note that there are differences in the ways work hours are defined between OECD countries (JILPT, 2013; Ogura, 2008).

Also, Research Institute for Advancement of Living Standards (2009) pointed that the average daily hours of overtime for Japanese workers, especially men, exceeded 100 minutes. Note that this number does not include hours of unpaid overtime, or so-called "service overtime." Therefore, if we are to include those hours, overtime work for Japanese workers will become even longer.

Historically, overtime work has been an integral part of Japanese management, and this "structured overtime" is one of the characteristics of the management in Japan. While firms are to pay extra to employees who work overtime,[4] Japanese employers in many cases load their employees with an amount of work that easily exceeds what an employee can handle within standard work hours (Sato, 2008). Japanese employers tend to view this mismatch necessary since it allows them to adjust flexibly the volume of work without firing employees during the time of recession. This mismatch is one of the important background factors that sustained Japanese long-term employment, and both employers and employees tacitly agree to maintain the system. However, just after the financial crisis in 2008, most Japanese employers started to impose restrictions on overtime work in order to reduce labor costs. A survey on Japanese employers' employment adjustment practices between 2009 and 2011 revealed that, followed by a temporary suspension of business and layoff, approximately 30% of Japanese enterprises regulated overtime work after the financial crisis (JILPT, 2014). In this survey, 42.1% of Japanese respondent firms reduced overtime work in 2008 (immediately after the financial crisis), and 34.7% in 2009 (See Table 2; JILPT, 2014). Due to this employer reduction of overtime, work hours for Japanese employees, including R&D engineers, were significantly cut down.

2. Changes in Japanese R&D Engineers' Work

Intensification in employer reduction of overtime after the financial crisis has caused unexpected problems in Japanese engineering workplaces. An earlier interview research conducted in Japanese manufacturing firms reported that engineers underwent a serious time shortage due to the overtime reduction, and as a result the incidences of experiencing incompletion/ non-accomplishment in work were growing among them (Fujimoto, Shinohara, Tanaka, & Nakata, 2013). In addition, managerial engineers and team leaders, who normally worked in discretionary labor system[5], were likely to be left with the job tasks that their subordinates could not complete within standard hours, so that the total amount of their work significantly increased, and more time pressure and stress were added on them.

In general, reduced overtime may be a blessing for workers. However, Fujimoto et al. (2013) pointed out that due to the intensified overtime reduction after the crisis a large number of Japanese employees, R&D engineers in particular, became increasingly unable to put in sufficient amount of time in work. Findings in this study showed that reduction of R&D engineers' work hours had a significant negative

[4] As a common practice in Japan, employees in managerial positions are treated as exempt. However, "the level and timing of assigning employees as exempt vary among firms depending on their own long standing practices" (Kuroda & Yamamoto, 2012, pp.252).

[5] Discretionary labor system is an example of the flexible work hour system, and it is designed to allow employees in certain designated jobs to decide on how they utilize their time when trying to accomplish their work. Research and development is one of the "professional services" jobs designated in the discretionary labor system. In addition, managers' work hours are usually not regulated by Japan's Labor Standards Act.

impact on the sense of accomplishment for Japanese engineers.

These results imply that reduction of overtime may carry a connotation for R&D for engineers different from what we typically believe about reducing workers' overtime.

Table 2. Employment Adjustment Practices between 2008 and 2011 in Japan

Year		2008	2009	2010	2011
Total Number of respondent companies	N	974	2,108	1,997	1,913
	%	100.0	100.0	100.0	100.0
Cutback in Overtime Work	N	410	731	591	529
	%	42.1	34.7	29.6	27.7
Standstill/Reduction of Employment of New School Leavers	N	203	344	337	309
	%	20.8	16.3	16.9	16.2
Standstill/Reduction of Mid-Career Recruitment	N	231	377	317	276
	%	23.7	17.9	15.9	14.4
Temporary Suspension of Business and Layoff (Daily)	N	477	1,499	1,342	1,281
	%	49.0	71.1	67.2	67.0
Temporary Suspension of Business and Layoff (Hourly)	N	154	379	373	406
	%	15.8	18.0	18.7	21.2

Source: JILPT (2014), p.60.

Note: Numbers in the table represent multiple responses.

(3) Theoretical Framework

Our main focus in this study is whether and how overtime reduction affects Japanese engineers' work experiences and their psychological well-being. We explore how reduced overtime influences engineers' job demands, unfinished work and workplace communication, and then how these in turn affect their work engagement and depression. We draw on the job demands-resources model to framework these relationships among Japanese R&D engineers.

1. Job Demands-Resources Model

Job demands-resources (JD-R) model (Demerouti, Bakker, Nachreiner & Shaufeli, 2001) focuses on two types of work conditions, i.e., job demands and job resources. Job demands refer to "characteristics of the job that potentially evoke strain, in case they exceed the employee's adaptive capability" (Bakker, Hakanen, Demerouti & Xanthopoulou, 2007). Specifically, job demands are "physical, social, or organizational aspects of the job that require sustained physical and/or psychological effort on the part of the employee, and are therefore associated with certain physiological and/or psychological costs" (Demerouti, Bakker, Nachreiner & Shaufeli, 2001). Examples of job demands include work pressure (including time pressure), emotional demands, adverse physical work environment, role ambiguity, role conflicts and overload.

Job resources, on the other hand, refer to work conditions that provide supportive means for employees when trying to accomplish their work. Specifically, job resources are "physical, psychological, social, or organizational aspects of the job that may (a) reduce job demands and the associated physiological and psychological costs, (b) are functional in achieving work goals, and (c) stimulate personal growth, learning and development" (Demerouti, Bakker, Nachreiner & Shaufeli, 2001). Job resources may be located in several different levels, including organization (e.g., salary, career opportunities, job security), inter-personal (e.g., supervisor and co-worker support), organization of work (e.g., role clarity, participation in decision-making), and task (e.g., performance feedback, skill variety, autonomy) (Bakker, Demerouti & Verbeke, 2004).

Generally, past research suggests that job demands and resources are negatively related to each other, because high demands are likely to prevent the mobilization of job resources, and availability of job resources are likely to reduce job demands (Bakker and Demerouti, 2007). JD-R model suggests that an increase in job demands and a decrease in job resources may deteriorate individuals' psychological well-being and reduce their work engagement.

Work engagement is defined as a positive work-related state of mind that is characterized by vigor, dedication and absorption (Shaufeli et al., 2002). Since vigor and dedication are considered as a reverse condition of exhaustion and cynicism, engagement is assumed to be negatively related to burnout (Shimazu et al., 2008). As Schaufeli et al. (2006) stress, work engagement and depression are negatively related, and engagement in work ameliorates individual mental health.

2. Analytic Model

The JD-R model emphasizes that job demands and resources are the two key determinants of employee well-being, and it is predicted that an increase in job demands and reduction in job resources are likely to result in deterioration of employees' work engagement and mental health. We argue that time is a job resource that engineers particularly value when they try to accomplish their work, and therefore overtime reduction necessarily decreases their valued resource of time, affecting the ways in which engineers engage in work.

Since overtime work is often allowed for when Japanese employers estimate the amount of work assigned to engineers, unless the total amount of work assignment is significantly cut back when overtime is reduced, they are likely to experience work overload and become unable to complete their assignment without extra work time to put in. Also in a situation like this, engineers may feel they have so little time for communication with others at work. Therefore, we expect that overtime reduction increases job demands and unfinished work for engineers, while it decreases the level of their workplace communication, and these in turn negatively affect engineers' work engagement and mental health.

Note that overtime reduction usually affects work hours for non-managerial engineers, making it more difficult for them to complete their work within standard work hours. However, the work that non-managerial engineers are unable to complete has to be finished by their managers and team leaders. Managerial engineers and team leaders in general take charge of a wider range of jobs. In addition, leaders and managers in R&D divisions tend to participate in multiple R&D teams/ projects. In consequence, their job demands may increase significantly when they must take on additionally their subordinates' unfinished tasks. Hence, the reduction of overtime work may affect managers and non-managers differently. We predict that overtime reduction has stronger impacts on engineers in managerial status, and it is likely to exert stronger influence on work engagement and mental health for managerial engineers. In this study, we test an analytic model as shown in Figure 1, using data collected from among R&D engineers in Japan.

(4) Methodology

1. Data

The data used in this study come from an online survey "Survey on Work and Life among Research and Development Workers" conducted by Fujimoto in March, 2012. Samples were taken from over 22,500 Japanese engineers registered at one online survey company, which consisted of 6,740 research and development engineers, 6,480 systems development engineers, 5,341 systems planning engineers. While the target number of respondents was set for 4,500, 4,482 engineers completed the survey. Our analytic sample for this study was 4,374 engineers, which consisted of 2,226 engineers in managerial positions and 2,148 engineers in non-managerial positions.

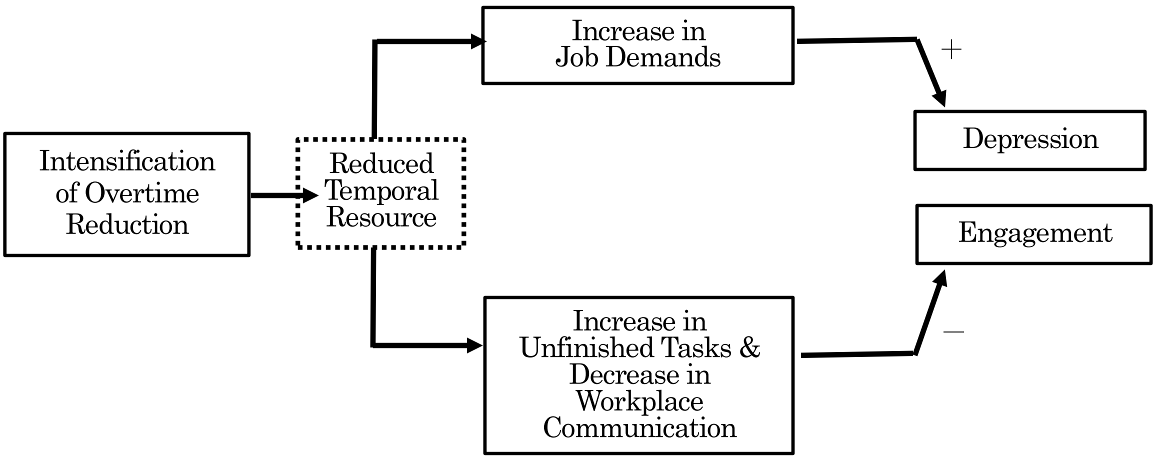

Figure 1. Analytic Model

2. Variables

2.1. Dependent Variable (1): Work Engagement

Work engagement was measured by using the shortened Japanese translation of Utrecht Work Engagement Scale (UWES, Schaufeli, Bakker, & Salanova, 2006; Shimazu et al., 2008). The 9 items in the shortened UWES represented 3 facets of engagement (vigor, dedication, and absorption), including items such as "At my work, I feel that I am bursting with energy (vigor)," "My job inspires me (dedication)," and "I get carried away when I am working (absorption)." Responses ranged from "1= strongly disagree" to "4= strongly agree", such that higher scores indicated stronger engagement in work. We computed the average of these 9 items and used it as a composite scale. The internal reliability (Cronbach's alpha) of the scale was .93 for managerial engineers and .94 for non- managerial engineers.

2.2. Dependent Variable (2): Depression

Depression was measured by using 10 items from the Japanese version of Self-reporting Depression Scale (Zung, 1965). Respondents were asked their physical and mental conditions (e.g., "I feel down and melancholy," "I cannot sleep at night" etc.) with a 4-point response scale (1 = hardly ever to 4 = always.) We computed the average of these 10 items and used it as a composite scale. The internal reliability of the scale was .60 for both managerial and non-managerial engineers.

2.3. Intervening Variable (1): Job Demands

Job demands was measured by a scale

which is the unweighted average of the following three items: "Do you think that the volume of work is balanced with the amount of time available in your workplace? (4=strongly disagree, 3=disagree, 2=agree, 1= strongly agree.) " "Because of a shorter delivery period, many people at my work cannot work satisfactorily." "During the past year, I have had very little time in delivering my work."(4=strongly agree to 1= strongly disagree.) The internal reliability of the scale was .64 for both managerial and non-managerial engineers.

2.4. Intervening Variable (2): Increase in Unfinished Work

Increase in unfinished work was measured by using a single item phrased "During the past year, I am increasingly being unable to finish my job (1= strongly disagree to 4= strongly agree)."

2.5. Intervening Variable (3): Decrease in Workplace Communication

Decrease in workplace communication was tapped by a single item phrased "During the past year, the atmosphere for communication has deteriorated at my work (1= strongly disagree to 4= strongly agree)."

2.6. Focal Independent Variable (1): Reduction in Overtime Work

The focal independent variable in this study was intensification of overtime reduction. Respondents were asked whether reduction in overtime work had been intensified during the five years prior to the survey (i.e., between 2007 and 2012). In our analysis, the variable was dummy-coded as 1= intensified, 0= no change or relaxed.

2.7. Focal Independent Variable (2): Managerial Status

Managerial status was coded as 1=manager, 0=non-manager.

2.8. Control Variables

We included the following independent variables as controls. First, years working for current employer were measured in years. We controlled for years working for current employer, instead of respondents' age, because these two variables are significantly and highly correlated each other (r=.662). Educational attainment was measured as 1=junior high school or high school, 2=some college, 3=college, 4=master degree, and 5=doctoral degree. Income in the past year (in Japanese yen) was coded as 1=less than 3 million yen (equivalent to approximately US \$35,000 or less), 2=3.00-3.49 million yen (approximately US \$35,000-40,000), 3=3.50-3.99 million yen, … 15=9.50-9.99 million yen, and 16= 10 million yen (approximately US \$120,000) or over. Monthly overwork hours were measured in hours. Number of projects currently involved was also controlled. Type of industry was dummy-coded, such as communication/IT (reference category), manufacturing, or other types of industry. Finally, area of work was dummy-coded as research (reference category), development/planning, information processing/software development, or other areas.

3. Statistical Procedure

Our analysis proceeded in two steps. First, we conducted mean comparisons between managerial and non-managerial engineers in overtime reduction, work engagement, depression and other major job outcome variables. Then, Ordinary Least Squares (OLS) regression models were estimated to examine (1) whether intensified overtime reduction exerts differential impacts on job demands, increase in unfinished work, and decrease in workplace communication for managerial and non-managerial engineers, and (2) whether and how the above work intervening variables in turn affect engineers' engagement and mental

Table 3. Mean Comparisons of Variables in Analysis: Managerial and Non-Managerial Engineers

	Managerial (N=2,226)		Non-Managerial (N=2,148)		
	Mean	S.D.	Mean	S.D.	Mean Difference
Focal Variables					
Intensified Overtime Reduction	.415	.493	.389	.488	†
Work Engagement	2.472	.616	2.263	.657	***
Depression	2.064	.346	2.047	.358	
Job Demands	2.631	.638	2.569	.666	***
Increase in Unfinished Work	2.460	.853	2.360	.903	***
Decrease in Workplace Communication	2.360	.770	2.320	.827	
Control Variables					
Sex (1=female)	.068	.252	.255	.436	***
Education	3.870	.976	3.880	1.013	
Marital Status (1=married)	.779	.415	.525	.499	***
Children (1=present)	.675	.469	.397	.489	***
Annual Income	9.220	4.529	5.050	3.522	***
Tenure	16.870	9.390	9.800	8.556	***
Recruitment Status (1=regular)	.560	.497	.500	.500	***
Employment Status (1=regular)	.530	.499	.620	.485	***
Monthly Hrs. of Overtime Work	78.470	73.352	67.660	72.376	***
N of projects R participates	2.920	3.588	2.130	3.273	***
Firm Size	3.620	1.499	3.560	1.469	
Job Type: Research (reference)	.101	.304	.119	.324	†
Job Type: Development	.320	.467	.305	.460	
Job Type: Systems Engineering	.342	.474	.364	.481	
Industry: Manufacturing	.417	.493	.401	.490	
Industry: IT (reference)	.334	.472	.380	.486	***
Industry: Other	.235	.424	.213	.409	†

Note: *** p<.001, ** p<.01, * p<.05, † p<.10

health.

(5) Results

1. Descriptive Results

Table 3 reports the results of t-tests conducted to examine the difference in mean scores between managerial and non-managerial engineers for all variables in analysis. First, we find that engineers in managerial positions were more likely than their non-managerial counterparts to experience intensification in overtime reduction. While at a marginal level (p<.10), the mean of overtime reduction was higher for managers (.415) than for non-managers (.389).

Mean comparison revealed that managers were more likely than non-mangers to engage in work. Mean scores of work engagement were 2.472 for managers and 2.263 for non-managers. Managers exhibited a significantly higher mean score in job demands (2.631) than non-managers (2.569). Also, managers perceived a significantly higher level of increase in unfinished work (2.460) than non-managers (2.360). However, we found no significant mean differences in depression and decrease in workplace communication between engineers in managerial and non-managerial positions.

Mean scores for indicators of demographic characteristics also showed differences between managerial and non-managerial engineers. For instance, significantly more non-managers were women (25.5%) than managers (6.8%). Managers' tenure in the current employer was significantly longer (16.87 years) than non-managers (9.80 years). While we observed no significant mean difference in educational attainment, managers earned a higher level of annual income (9.220) than non-managers (5.050). Managers worked significantly longer monthly hours of overtime (78.470 hours) compared with non-managers (67.660 hours), and managers were also involved in more projects (2.920) than non-managers (2.130). Thus, managers were working more intensively than non-managers in our sample. We found no statistically significant mean differences in firm size and type of industry. As to job type, non-managers were slightly more likely (11.9%) than managers (10.1%) to work in research, while approximately equal proportion of managers and non-managers were working in development/planning and systems engineering. In terms of family status, managers were much more likely (77.9%) than non-managers to have spouse (52.5%). Managers were significantly more likely (67.5%) than non-managers (39.7%) to have children in the household.

2. Multivariate Results

Table 4 reports the result of OLS regression predicting job demands, increase in unfinished work, and decrease in workplace communication. First, the regression result for job demands indicate that intensified overtime reduction is likely to increase engineers' job demands, and managerial engineers were significantly more likely than non-managerial engineers to feel burdened with their high job demands. Yet, we found no significant interaction effect of over time reduction and managerial status. Several demographic characteristics were significantly associated with job demands. For instance, women were less likely to experience high job demands compared with men. Higher income level and longer tenure were negatively associated with job demands, while longer hours of overtime and more projects currently involved were positively related to job demands. Those who were in manufacturing industry were more likely to experience a higher level of job demands than those in other industries. Engineers in development and systems engineering were more likely to be burdened with demands, compared to those who were in research.

Second, we find that intensification of overtime reduction tends to increase engineers' unfinished work, and that those in managerial positions were significantly more likely than their counterparts in non-managerial positions to experience an increase in unfinished work, when controlling for demographic conditions. Yet here again, we found no significant interaction effect of over time reduction and

Table 4. OLS Regression Coefficients for Models of Job Demands, Increase in Unfinished Work, and Decrease in Workplace Communication

	Job Demands		Increase in Unfinished Work		Decrease in Workplace Communication	
	beta	Sig	beta	Sig	beta	Sig
Overtime Reduction	.206	***	.101	***	.098	***
Manager	.057	***	.072	***	.016	
《Interaction Term》 Overtime Reduction * Manager	.010		.016		-.003	
Sex (1=female)	-.059	***	-.037	*	-.049	**
Education	.023		.020		.021	
Marital Status (1=married)	.013		.021		.011	
Children (1=present)	-.018		-.042	*	.010	
Annual Income	-.063	**	-.016		-.048	*
Tenure	-.045	*	-.095	***	.033	+
Recruitment Status (1=regular)	.034	*	.068	***	-.038	*
Employment Status (1=regular)	-.020		-.033	*	.032	*
Monthly Hrs. of Overtime Work	.033	*	.049	***	.031	*
N of Projects R Participates	.085	***	.067	***	-.007	
Firm Size	-.021		.004		.005	
Development	.144	***	.030		.013	
Systems Engineering	.117	***	.011		-.008	
Other Job Types	.034		-.033		.006	
Manufacturing	.036	*	.022		.017	
R^2	.073		.035		.015	

Note: + p<.10, * p<.05, **p<.01, ***p<.001

Coefficients indicated in table are standardized beta coefficients.

Reference category for job type is basic & applied research.

managerial status. Several demographic characteristics were significantly associated with increase in unfinished work. For instance, women were less likely than men to experience increase in unfinished work. Longer tenure was negatively associated with the increased unfinished work, while working longer hours of overtime and being involved in more projects were positively related to the increase.

Third, while overtime reduction does decrease workplace communication, we found no significant effect of being in managerial position on the decreased communication at work. Here again, sex exhibited a significant negative effect, indicating that women were less likely than men to feel the decrease in workplace communication. Those who earn higher annual

Table 5. OLS Regression Coefficients for Model of Work Engagement

	Work Engagement			
	Model 1		Model 2	
	beta	Sig	beta	Sig
Overtime Reduction	-.057	***	-.022	
Manager	.091	***	.093	***
《Interaction Term》 Overtime Reduction * Manager	-.016		-.017	
Sex (1=female)	.058	***	.047	**
Education	.006		.010	
Marital Status (1=married)	.029		.029	
Children (1=present)	.029		.033	
Annual Income	.113	***	.098	***
Tenure	.021		.030	
Recruitment Status (1=regular)	-.022		-.029	+
Employment Status (1=regular)	-.055	***	-.050	***
Monthly Hours of Overtime Work	.029	+	.031	*
Number of Projects R Participates	.065	***	.070	***
Firm Size	-.047	**	-.051	**
Development	-.096	***	-.071	**
Systems Engineering	-.158	***	-.138	***
Other Job Types	-.079	***	-.067	**
Manufacturing	.023		.029	+
Job Demands			-.197	***
Increased in Unfinished Work			.155	***
Decrease in Workplace Communication			-.109	***
R^2	.069		.114	

Note: + p<.10, * p<.05, **p<.01, ***p<.001

Coefficients indicated in table are standardized beta coefficients.

Reference category for job type is basic & applied research.

income are less likely to feel the decrease in communication. Longer tenure was positively associated with the decreased communication, while longer overtime was negatively related to the decrease.

Tables 5 and 6 show the results of OLS regression predicting work engagement and depression. First, we examined whether intensification in overtime reduction exerted a direct impact on each dependent variable (Model 1). Then we entered additionally job demands, increase in unfinished work, and decrease in order to examine whether and how these intervening variables affect engagement and depression, and whether intensification of overtime reduction affect engagement and de-

Table 6. OLS Regression Coefficients for Model of Depression

	Depression			
	Model 1		Model 2	
	beta	Sig	beta	Sig
Overtime Reduction	-.012		-.033	*
Manager	.025		.016	
《Interaction Term》 Overtime Reduction * Manager	-.007		-.009	
Sex (1=female)	.098	***	.105	***
Education	.034	+	.031	+
Marital Status (1=married)	.016		.013	
Children (1=present)	-.017		-.013	
Annual Income	.042	*	.048	*
Tenure	-.015		-.006	
Recruitment Status (1=regular)	.013		.007	
Employment Status (1=regular)	.004		.006	
Monthly Hours of Overtime work	.027	+	.020	
Number of Projects R Participates	.074	***	.065	***
Firm Size	-.018		-.017	
Development	.012		.002	
Systems Engineering	-.043		-.050	+
Other Job Types	.015		.016	
Manufacturing	-.022		-.026	
Job Demands			.048	**
Increased in Unfinished Work			.082	***
Decrease in Workplace Communication			.027	+
R^2	.017		.032	

Note: + p<.10, * p<.05, **p<.01, ***p<.001

Coefficients indicated in table are standardized beta coefficients.

Reference category for job type is basic & applied research.

pression only through these intervening variables.

As reported in Table 5, the result in Model 1 for work engagement shows that intensified overtime reduction exerted a significant negative impact on work engagement. However, when we added job demands, increase in unfinished work, and decrease in workplace communication in Model 2, the negative effect of overtime reduction was reduced to non-significance. These results suggest that intensification in overtime reduction affects work engagement only via these intervening variables.

All three intervening variables entered Model 2 exhibited statistically significant effects on work engagement. Job demands and decreased workplace communication were likely to reduce work engagement, whereas increased unfinished work was likely to enhance engagement for engineers.

The regression results in Models 1 and 2 also show that managerial engineers were significantly more likely than non-managerial engineers to be engaged in work, controlling for various demographic characteristics. Here again, we found no significant interaction effect of over time reduction and managerial status. Several demographic characteristics were significantly related to work engagement (Model 2). For instance, women were more likely to be engaged in work compared with men. Higher income level and more projects currently involved were positively associated with engagement, while working in larger firms was negatively related to engagement. Those who worked in manufacturing industry were more likely to engage in work than those in other industries. Work engagement for engineers in research and development tends to be higher than those who were in other types of engineering jobs. Turning to the results for depression (Table 6), intensified overtime reduction exerted no significant effect on depression. In Model 2, however, the negative effect of overtime reduction turned statistically significant after controlling for job demands, increase in unfinished work, and decrease in workplace communication. These results suggest that intensification in overtime reduction has a direct impact on depression, in addition to the indirect effects via job demands, increase in unfinished work, and decreased workplace communication.

The results in Model 2 revealed that higher job demands and increase in unfinished work are likely to deteriorate engineers' mental health. Decreased workplace communication also exerted a positive influence on depression, yet the effect was only marginally significant ($p<.10$).

The regression results for depression (Model 2) also revealed that women were more likely than men to be depressed, and those who earned higher income and had more project assignments were more likely to feel depressed. We found no significant effect of managerial status on depression in Models 1 and 2.

(6) Discussion and Conclusion

Present results show that recent intensification in overtime reduction in Japanese firms has negatively affected Japanese R&D engineers' work. We found that overtime reduction increased their job demands and unfinished work, while it decreased the level of their workplace communication. We also found that Job demands and decreased workplace communication were likely to reduce work engagement, whereas an increase in unfinished work was likely to enhance engagement for Japanese engineers. We predicted that overtime reduction would exhibit stronger impacts on engineers in managerial status, and that it would exert a stronger influence on work engagement and mental health for managerial engineers. While managers were marginally more likely than their non- managerial counterparts to perceive the intensification of overtime reduction, we observed no differences in the effect of overtime reduction on work engagement and depression for engineers in managerial and non-managerial positions. Thus, intensified reduction of overtime work has negative influence on Japanese engineers irrespective of their managerial status.

We also found that intensification in

overtime reduction only indirectly affects engineers' work engagement via job demands, increase in unfinished work, and decreased workplace communication, whereas it has both direct and indirect impacts on depression.

Findings in the present study raised questions about the commonly held perception of long hours of work for Japanese employees. Overtime reduction for Japanese engineers may have both positive and negative sides, and while on one hand it enhances the time availability for their life outside paid employment, on the other hand it reduces the adequacy in time spent for work. As Yoshimura (2007) claims, scientists in general are highly involved in their jobs, meaning that work tends to be their central life interest, and it is an important source of their identity. While we found a positive association between an increase in unfinished work and work engagement, it may be that engineers become all the more absorbed in work when they feel their work-centered identity is threatened by not being able to accomplish their work.

In order to strike an adequate balance between work and life, it is not sufficient to just reduce time at work, but it is also necessary to evaluate the adequacy in work time simultaneously. Although employers may generally believe that reducing employees' overtime work is an effective means to reduce labor costs, it is important that they realize immoderate work time regulation may bring about unintended negative consequences in engineers' work. In order to improve the well-being and creativity for R&D engineers believed to be motivated by intrinsic aspects of work (fun, challenges etc.), it is necessary to carefully examine the role of "time management." Our finding that work engagement for engineers in development and systems engineering is lower than those in basic research has an implication that we must pay attention to how engineers in different job types work. We will need to compare how time at work is differentially experienced by those who work under tight schedule control and those who do not, in order to evaluate the role of "time management" for engineers in different job types.

Finally, the limitations of the present study need be mentioned. First, the data used in this study did not allow us to look more carefully at how overtime reduction affected other aspects of engineers' work, such as voluntary unpaid overtime. While some may argue that reduced paid overtime is compensated by increase in unpaid overtime, our data did not include information to examine whether this was true, and to our best knowledge there is no public data available to see whether unpaid "service" overtime increased between 2007 and 2012.

Perhaps our conceptual model requires a wider scope to capture the processes through which overtime reduction affects engineers' work. In addition, although we looked at the impact of managerial status in our analysis and how the effect of overtime reduction is conditioned by incumbency in a managerial position, we did not carefully compare the ways that managerial and non-managerial engineers worked. Future research should also look at whether and how intensified overtime reduction has exerted differential impacts on the work and non-work lives for managerial and non-managerial engineers.

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