Managing Individual Autonomy to Increase Intrinsic Motivation within a New Product Development Organization in Japan

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Abstract--Intrinsic motivation is one of the most important individual factors to enhance the team's creativity in New Product Development (NPD). Many social psychological studies have pointed out that intrinsic motivation is heightened through enhancing individual autonomy. However, managing individual autonomy in a work situation has not yet been adequately addressed nor discussed in detail.

In this research, we investigated how to improve individual autonomy focusing on NPD personnel, such as those in design, development, manufacturing and quality-control, as well as in marketing departments. From questionnaire data collected from 242 NPD members within a Japanese industrial machine manufacturing company, we quantitatively analyzed the effects of various ways of giving autonomy to individuals. The results of this statistical analysis showed that individual autonomy was enhanced only when individuals could decide what they should accomplish in their work and how they should do their work. We revealed the importance of autonomy in motivating working professionals intrinsically, and how autonomy could be effectively given to individuals in a work situation. Also, we found that autonomy given to individuals had no direct effect on intrinsic motivation.

I. INTRODUCTION

The NPD activities are essentially creative activities [1], because, NPD members cannot clearly and rationally articulate end-product's shape from the very beginning. In such creative and uncertain activities, the individual level of analysis is needed for considering NPD activities. However, NPD management research has not been focused enough onto the individuals, although worthwhile ideas and knowledge regarding the nature of creativity are ultimately created by individuals.

Prior research indicates the importance of the intrinsic motivation of the individual for creativity in an uncertain work environment [2][3][4]. To enhance intrinsic motivation in a work context, a number of studies have indicated the importance of individual autonomy [5][6]. The effects of individual autonomy are not limited to enhancing intrinsic motivation but also include enhancing individual creativity. A number of studies have explored the relationship between individual autonomy and job satisfaction [7][12]. They imply that when individuals act autonomously, they are inclined to acquire, to relate and to interpret new knowledge [8].

The purpose of the present study is to investigate empirically and statistically how we can effectively improve individual autonomy to increase intrinsic motivation using social psychological theory.

II. THEORETICAL BACKGROUND

Research on work motivation has classified motivation into two types: intrinsic motivation and extrinsic motivation. Intrinsic motivation was illustrated in the 1970s by Deci, a social psychologist [5]. Intrinsic motivation is a motivational state of obtaining intrinsic rewards, such as feelings of accomplishment of work, self-growth, and fun from work. In other words, it is motivated by work itself. On the other hand, extrinsic motivation typically aims for extrinsic rewards which are used as incentives, such as money and position in work. In other words, it is motivated by rewards received from outside. Extrinsic motivation is also understood as a motivational state obeying extrinsic stimuli such as threats of punishment, deadlines, imposed goals, surveillance and evaluation [9].

Obviously, extrinsic rewards and stimuli constitute a powerful force to motivate. However, this must be problematic for creativity. Because, once individuals are oriented toward extrinsic rewards, they are likely to take the shortest or quickest path to get them. Usually, the shortest path won't provide new insights into the nature of the problem or reveal new ways of looking at it [10]. Other studies indicate that intrinsic motivation fits in well with qualitative and effective work, and meanwhile extrinsic motivation fits in well with quantitative and efficient work [8][11]. These arguments lead to the importance of intrinsic motivation for NPD activities.

According to Deci's theory, intrinsic motivation is enhanced by satisfaction of three basic needs, which are autonomy, competence and relatedness [5][8]. He suggests that the autonomy is the main factor, and intrinsic motivation is not enhanced without a sense of autonomy. They focus on innerpersonal state in social psychology.

In management research, autonomy is the degree of freedom and discretion an individual has in carrying out assigned tasks [12][13]. In other word, autonomy can be measured by the level of delegation given to his/her work. However, social psychologists have mentioned "autonomy having a sense of self-determination", not just "delegation" from management side. When we think autonomy to increase intrinsic motivation, we should focus on innerpersonal state. We define autonomy as individual condition having a sense of self-determination in an organization.

Bailyn [14] illustrates two types of autonomy, strategic and operational, by investigating R&D personnel within corporate laboratories. Strategic autonomy is the freedom of setting one's own research agenda, and operational autonomy

is the freedom, once a problem has been set, of determining by oneself, within given resource constraints [14]. Bailyn emphasizes the need to give autonomy that suits an individual career, such as giving operational autonomy in the early career stage for human resource development, and giving strategic autonomy to middle managers. Autonomy with a sense of self-determination is also affected by an autonomy-supportive environment [15]. Autonomy is not only simply given to individuals, but also given in an autonomous environment that is freedom of deciding what to do or how to do their work [2][15].

III. RESEARCH HYPOTHESES

In this section, a model of how autonomy and delegation directly influences intrinsic motivation in an NPD organization is developed. Based on our theoretical background, we posit a research model, as shown in Figure 1, and set the following three hypotheses.

As we have discussed, autonomy with self-determination is considered to improve intrinsic motivation. However, delegation without a sense of self-determination means being controlled by anyone else. "delegation itself" will not improve intrinsic motivation. Delegation may improve autonomy, but will not improve intrinsic motivation directly. Thus, autonomy will mediate the link between delegation and intrinsic motivation.

Hypothesis 1: *Autonomy will mediate the relationship between intrinsic motivation and delegation.*

Autonomy does not necessarily mean selfish behavior [9]. An autonomous environment positively stimulates individuals to work together in an organization [2]. Such opportunities lead to autonomy that does not necessarily mean independence in an organization. Thus, autonomous environment offering both freedom and delegation to individuals will spur a sense of autonomy.

Hypothesis 2: *Delegation and an autonomous environment will enhance autonomy.*

The necessity of delegation in carrying out tasks is different between operational side and managerial side [14]. For lower-level employees who have insufficient work experience and skills, giving strategic autonomy to them may cause unnecessary confusion to their work. Meanwhile, for middle managers, giving strategic autonomy to them will lead to managing wider range of their work effectively. When we consider how to give autonomy to increase intrinsic motivation in an NPD organization, giving only operational autonomy to lower-level employees and giving strategic autonomy to middle managers is a right way for effective management of autonomy.

Hypothesis 3: *For lower-class employees, giving how to do their work will increase their autonomy, while for managers, giving what to do their work will increase their autonomy.*

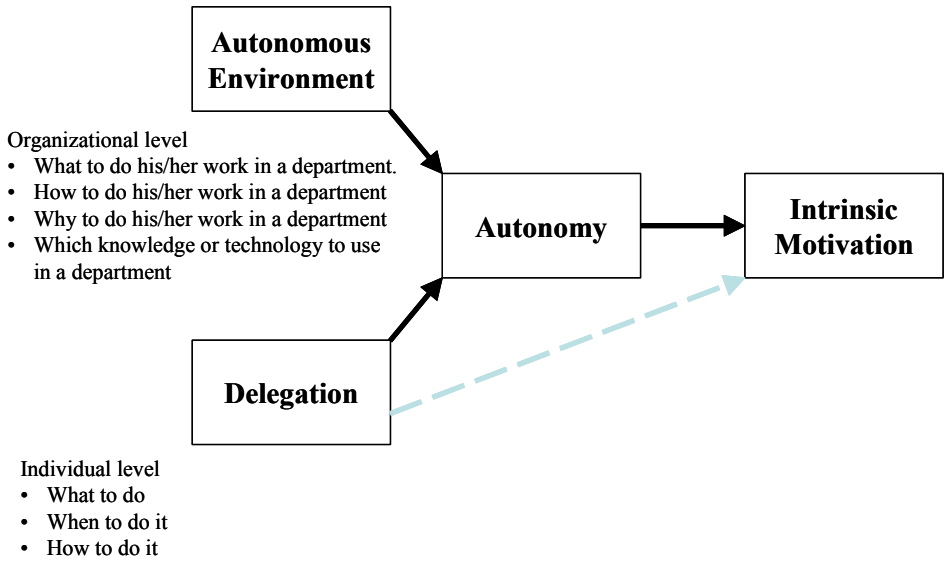


Figure 1. The research model

IV. METHODS

A. Data

Data for this research was obtained by a questionnaire survey of NPD personnel in a Japanese industrial machine manufacturing company conducted in August, 2007. Respondents were limited to NPD personnel, such as those in design, development, manufacturing and quality-control, as well as marketing departments, excluding workers who were working as manual laborers. Of 409 questionnaires

distributed to NPD personnel, 242 were usable for our analyses. The average age of the respondents was 45.1 (median = 45.0).

B. Measures

The survey instrument measured a number of variables such as intrinsic motivation, autonomy, delegation and autonomous environment, etc.. All items were measured by Likert scale ranging from 1 = completely disagree to 5 = completely agree. Appendix A shows the questionnaire items we used and Appendix B shows the results of principal component analysis.

Intrinsic motivation was measured by using four items on the basis of Gagne et al.'s work [16]. The concept of intrinsic motivation was constructed by principle component analysis. The four items were getting a feeling of accomplishment from work (IM1), hoping to keep up one's own work (IM2), accepting more work (IM3), and trying more difficult work without salary or bonus being increased (IM4). The principle component analysis only yielded one factor as we expected, (eigenvalue = 2.76) conditioned with one or more eigenvalue. The Cronbach alpha of these items was 0.74.

Autonomy with a sense of self-determination was measured by four items on the basis of Takahashi's [17] scale. He developed a self-determination scale for Japanese white-collar workers, based on Deci's self-determination theory. Items included authority given by his/her supervisors, freedom to do his/her work, acceptance of his/her suggestions, and formulating objectives for the company. The Cronbach alpha of the four items was 0.82.

Delegation was measured by three items, based on Breaugh's [18] scale, and had a Cronbach alpha of 0.82. Items measured the level of delegation, for example, methods and the procedures, the scheduling, and the objectives and evaluation of their work.

Autonomous environment was measured by four items on the basis of Amabile's [2] theoretical and experimental framework, which indicates influence of supporting autonomy on intrinsic motivation within an organization. As an organizational and autonomous environment, we focused on clear strategic direction with autonomy and constructive work-forced feedback [2]. Each respondent evaluated the level of how much his/her department had made him/her feel freedom in making (for example) decision of what to do about the work, how to do about the work, what technology or knowledge to be utilized for the work, and the level of information about the reasons for the work to be delegated. This four-item scale had a Cronbach alpha of 0.78.

Three demographic variables were included in this questionnaire. First, the level of *work positions* was classified into four categories, "employee with no title," "subsection chief," "section chief," and "head of department". These work positions were categorized into two; lower-class employees and middle managers, because their formal authorities are distinctly different from each other. Second, *service years* within the company were measured by yearly-based. Third, personnel *rotation* in the company was measured by total number of different departments the respondent experienced. In Japanese companies, personnel rotation is often implemented for attaining job enrichment.

C. Analysis

To test the mediator effect in Hypothesis 1, we used the three-step-equation approach recommended by Baron and Kenny [19] for controlling the demographic variables. First, the independent variable is regressed on the mediator. Second, the dependent variable is regressed on the independent variable. Third, the dependent variable is regressed on both the mediator and the independent variable. If the independent variable has a significant effect on the mediator in the first step, and a significant effect on the dependent variable in the second step, and if the mediator has a significant effect on the dependent variable and the independent variable has no effect on the dependent variable in the third step, the mediator holds perfectly.

In the analysis, we thought the levels of autonomy would be different between lower-class employees and middle managers, although the same psychological mechanism exists. Therefore, we distinctly made a regression model for each of lower-class employees and middle managers to test Hypotheses 1 and 2.

To test Hypothesis 3, we used a causal indicator model [20] in the structural equation modeling. In the analysis, we constructed each concept by using principle component analysis, for analytical consistency.

V. RESULTS

Tables 1 and 2 show results from mediated regression analysis. Table 1 for lower-class employees shows an effect of delegation on autonomy in Step 1, and also shows a significant effect of delegation on intrinsic motivation in Step 2. In Step 3, when both autonomy and delegation were included, delegation has no effect on intrinsic motivation. Similarly, Table 2 for middle managers shows almost the same results for delegation. This provides a strong and consistent support for Hypothesis 1.

Tables 1 and 2 show that delegation significantly and positively affects autonomy in Step 1, which supports Hypothesis 2.

Table 1 shows that autonomy is significantly affected by control variables, service years and rotation times, but Table 2, the result of middle managers in the Step 1 to 3, shows no effects of service years and rotation times on autonomy.

TABLE 1. MEDIATED REGRESSION ANALYSIS FOR LOWER-CLASS EMPLOYEES

	Step1		Step 2		Step 3	
	Autonomy		Intrinsic motivation		Intrinsic motivation	
	Coefficient	VIF	Coefficient	VIF	Coefficient	VIF
Service years	**0.144** *	1.21	-0.045	1.20	-0.056	1.22
Rotations	**-0.147** *	1.17	0.130	1.17	**0.192** **	1.20
Autonomy					**0.438** ***	1.43
Delegation	**0.454** ***	1.11	**0.346** ***	1.05	0.117	1.44
Environment	**0.292** ***	1.06				
Adj. R^2	0.367		0.132		0.264	
F-value	24.665 ***		9.292 ***		15.700 ***	
n	164		165		165	

Note: Coefficient is standardized. * p< .05, ** p< .01, *** p< .001

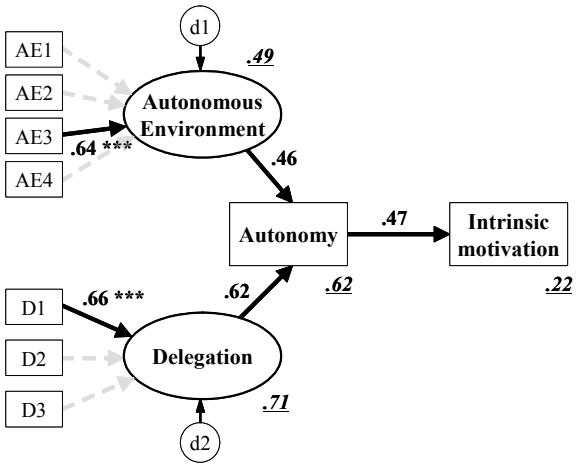
TABLE 2. MEDIATED REGRESSION ANALYSIS FOR MIDDLE MANAGERS

	Step1		Step 2		Step 3	
	Autonomy		Intrinsic motivation		Intrinsic motivation	
	Coefficient	VIF	Coefficient	VIF	Coefficient	VIF
Service years	0.144	1.06	0.136	1.04	0.019	1.08
Rotations	0.008	1.02	0.050	1.00	0.073	1.00
Autonomy					**0.663** ***	1.34
Delegation	**0.347** **	1.12	**0.242** *	1.04	-0.048	1.30
Environment	**0.320** **	1.12				
Adj. R^2	0.302		0.056		0.390	
F-value	9.107 ***		2.516 +		13.125 ***	
n	76		77		77	

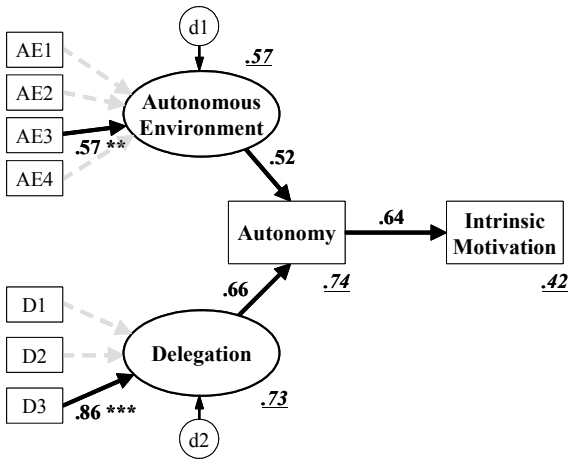
Note: Coefficient is standardized. + < .065, * p< .05, ** p< .01, *** p< .001

Figure 2 shows results of standardized structural equation modeling of multiple populations on the basis of the research model. The Models have significant explanatory power (GFI=.983, CFI=.989, RMSEA=.041, italic number with underbar means variance of each component. The predictors of each component explain the percent of its variance). Cause-effect relationships among four components have significant effects, the same as the results of regression analysis. The Results indicate different characteristics of delegation. Figure 2(a) for employees shows that only D1, "The decision of the methods and the procedures (how I do to use) of my work is given to me", has a significant and positive effect on delegation, and Figure 2(b) for middle managers shows that only D3, "The decision of the objectives and the evaluation (what I am supposed to accomplish) of my work is given to me", has a significant and positive effect on delegation. These provide supports for Hypothesis 3.

In the analysis, an autonomous environment was analyzed. Figures 2(a) and 2(b) show that only AE3, "In my department, we are informed of the reasons for the work to be delegated to us", has a significant and positive effect on autonomous environment.



(a) Employees



(b) Middle managers

Figure 2. Structural equation modeling

VI. DISCUSSION

This research examines how to effectively improve individual autonomy and intrinsic motivation. The results suggest that autonomy with self-determination spurs intrinsic motivation, but, delegation does not improve intrinsic motivation directly. Delegation and autonomous environment both improve individual autonomy positively. Especially, when lower-class employees are allowed to make decisions on the methods and the procedures (how to do), and when middle managers are allowed to make decisions on the objectives and evaluations (what to do), autonomy strongly improves. And, when an employee knows the reasons for delegation, autonomy also strongly improves.

Concerning the result of the mediated regression, autonomy is significantly affected by control variables, service years and rotation times, while the results of middle managers show no effects of service years and rotation times. This implies that service years may mean the enhancement of relevance to social roles, such as more freedom of action with responsibilities and self-determination. The number of rotation times has a negative effect on autonomy. In general, as the number of rotation times increases, duration of belonging to a department becomes shorter. Frequent rotation times could reduce opportunities of coming up with solutions and practices through trial-and-error, and consequently, it may decrease the importance of social role in an organization. On the other hand, because middle managers have already had higher level of autonomy (mean: employees=2.99, middle managers=3.64), the result must be showing no effects of service years and rotation times on autonomy and intrinsic motivation.

The results of this study have a number of practical implications for intrinsic motivation management in NPD organization. First of all, how to give autonomy requires different managerial practice depending on employee's positions. The results indicate that improving autonomy needs not only to delegate the responsibility to personnel, but also to oversee with sense of self-determination. This means, managers should not only give autonomy to employees, but also they should monitor personnel's feeling of self-determination. Also, managers ought to explain to employees what to do and why they work. Delegation is important to improve intrinsic motivation, but the more important factor is "autonomy with self-determination."

As we focused on autonomy at the individual level in a Japanese manufacturing company, the generalizability to deeper mechanisms has yet to be illustrated. Therefore, besides analyzing with the statistical approach, we also need to investigate the context of autonomy by in-depths interviews in the company. Future work will be done to investigate how to give autonomy and how to improve its influence qualitatively.

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APPENDIX A: QUESTIONNAIRE ITEMS

Autonomy

A1: Authority is given to me by my supervisors.
A2: I feel freedom is given to do my work.
A3: The suggestions I make are almost accepted by my supervisors.
A4: I formulate objectives on the basis of the vision of my company.

Autonomous Environment

AE1: In my department, we are allowed to decide what to do (work contents).

AE2: In my department, we are allowed to choose how to do our work (methods).

AE3: In my department, we are informed of the reasons for the work to be delegated to us.

AE4: In my department, we are allowed to decide what technology or knowledge to be utilized for our work.

Delegation

D1: The decision of the methods and the procedures (How I do to use) of my work is given to me.

D2: The decision of the scheduling (when I do what) of my work is given to me.

D3: The decision of the objectives and the evaluation (what I am supposed to accomplish) of my work is given to me.

APPENDIX B: FACTOR LOADINGS BY PRINCIPAL COMPONENT ANALYSIS OF THE AUTONOMY ITEMS AND DESCRIPTIVE STATISTICS

Factors / Items	Factor Loading			Mean	S.D.
	1	2	3		
Autonomy				3.20	0.798
A1:	**.745**	.340	.047	2.98	1.142
A2:	**.665**	.463	.106	3.33	0.991
A3:	**.725**	.100	.312	3.40	0.889
A4:	**.795**	.168	.103	3.10	0.933
Autonomous Environment				3.21	0.717
AE1:	.017	.195	**.809**	3.17	0.985
AE2:	.042	.248	**.841**	3.45	0.858
AE3:	.483	-.185	**.611**	2.92	0.959
AE4:	.289	-.009	**.714**	3.30	0.884
Delegation				3.65	0.761
D1:	.129	**.830**	.053	3.63	0.940
D2:	.170	**.803**	.111	3.85	0.822
D3:	.306	**.780**	.138	3.47	0.908

Both a scree plot and an Eigenvalue cutoff with 1.0 and above yielded three factors.