Proposal of Knowledge Creation Process for Innovation Aim in Research and Development

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Abstract: Motivation improvement of researchers is essential to facilitate knowledge creation for innovation aim in research and development organizations. This is because the knowledge that is the source of innovation is ultimately created by individual researchers themselves, and motivation is a determining factor in the quality of research and development activities performed by those researchers. According to previous research into the relationship between creativity and motivation, intrinsic motivation is necessary for individual creative realization. Our research has as its goal the creation of a process model for research and development management that allows for continued improvement of motivation. By adding a mechanism to increase motivation for further research to support the creation of knowledge, and conducted research aims to conduct more effective innovation.
Key Words: Innovation; Motivation; Creativity; Intrinsic motivation

1 Introduction

1.1 The Current Situation in Japan

At present, scientific and technical innovation is being emphasized not only in the United States and EU countries, but also in the BRIC countries. The goal is increased resource loading for research and development (R&D), and rapid expansion has continued, particularly in Asian countries.

With regards to industrial competitiveness too, despite the fact that Japan had a leading share of international high tech industries in the 1980s, that share has declined over recent years

while China's has continued to increase, a reflection of the remarkable progress of the other Asian countries[1]. In terms of world aging trends and predictions, Japan has the highest population aging rate (the ratio of the population that is 65 years old or older) in the world, while at the same time it has the second worst birth rate, at only 1.26[2]. These factors have led to a rapidly deteriorating workforce, and increased GDP as a result of increased labor element input (i.e., economic expansion) is not predicted.

As a result of these problems related to reduction of the workforce, methods for increasing productivity through technological innovation and advancement are attracting attention as potential ways of generating large levels of production with limited labor resources. Innovation is one method of improving productivity, and in order for Japanese companies to maintain and improve their competitiveness within international society through sustained knowledge generation, it will be necessary to further improve their internal functional capacities for R&D.

1.2 Relationship Between Knowledge Creation and Motivation in R&D

Increasing researcher motivation is vitally important in R&D organizations. This is because the knowledge that is the source of innovation is ultimately created by individual researchers themselves, and motivation is a determining factor in the quality of R&D activities performed by those researchers[3]. The motivation of R&D personnel is a fundamental element in R&D efforts, and it is an important topic in that its management affects not only personnel management but also innovation management. Therefore, in order to knowledge creation within R&D, it is necessary to simultaneously improve motivation.

Motivation provides incentive to perform work, and is classified into two types: intrinsic motivation, which is oriented toward internal factors such as feelings of accomplishment and personal growth, and extrinsic motivation, which is oriented toward external factors such as duty, rewards and punishment, and coercion. According to Amabile, who has performed research related to creativity for many years, individuals must have intrinsic motives in order to exhibit creativity. He describes three components that are necessary for creativity: expertise, creative thinking skills, and intrinsic motivation[3]. Of these three, increasing intrinsic motivation requires the least amount of time and is a relatively simple way of increasing creativity. Shally and Perry-Smith (2001) examined two aspects of rewards, and by comparing the results of controlling aspects showed that high levels of intrinsic motivation and creative performance were attained when rewards were not financial, but rather informational[4].

From the above, we believe that in order to increase knowledge creation in R&D, it is effective to simultaneously increase the intrinsic motivation of researchers, who are the source of creativity.

2 An Investigation of Methods to Motivation Improvement and Knowledge Creation in Research and Development

2.1 Methods for knowledge creation in R&D

The generation of organizational innovation refers to the new creation (production) of technologies and knowledge above that born from the enterprise environment, at each of the individual, group, and organizational levels. Individual ideas and knowledge, the basis for innovation, are created through the continual transformation of implicit and explicit knowledge.

Individual knowledge is accumulated through experience and, in the case of non-verbalized tacit knowledge, cannot be shared as-is with others. If one is to use knowledge to create new knowledge, then it is necessary to verbalize tacit knowledge and thereby transform it into explicit knowledge. Thus, the process of formalization of tacit knowledge is an important one.

Therefore, we created a knowledge creation process in research and development. SECI process which is basic theory of knowledge management is applied to this. SECI process is one of mutual transformation between implicit and explicit knowledge, as well as a qualitative and quantitative development of knowledge through a cyclical process, and its use can lead to increased effectiveness of organizational innovation creation.

2.2 Methods for motivation improvement

According to the goal setting theory espoused by Locke, differences in motivation are seen as differences in goal setting. It has been established that with regards to goals that are accepted by individuals, clear goals produce better results than vague ones, and challenging goals produce better results than non-challenging ones. Goal setting that involves feedback has also been shown to have a higher motivational effect[6].

Therefore, PF introduce a system based on management by objectives management by objectives proposed by Drucker. Fill out the card at each step of management by objective goals, motivation can increase the effectiveness evaluation after further steps.

3 Proposal of Knowledge Creation Process for Innovation Aim in Research and Development

Figure 1 explains the knowledge creation process for innovation aim in research and development. The model divides the steps for creating Knowledge into four steps: “idea generation”, “formalization”, “knowledge sharing”, and “development”. Researchers perform work related to creating knowledge at each step, and engage in active communication and goal sharing with each other throughout all of the innovation steps. Doing so allows for achieving intrinsic motivation and engaging in creativity.

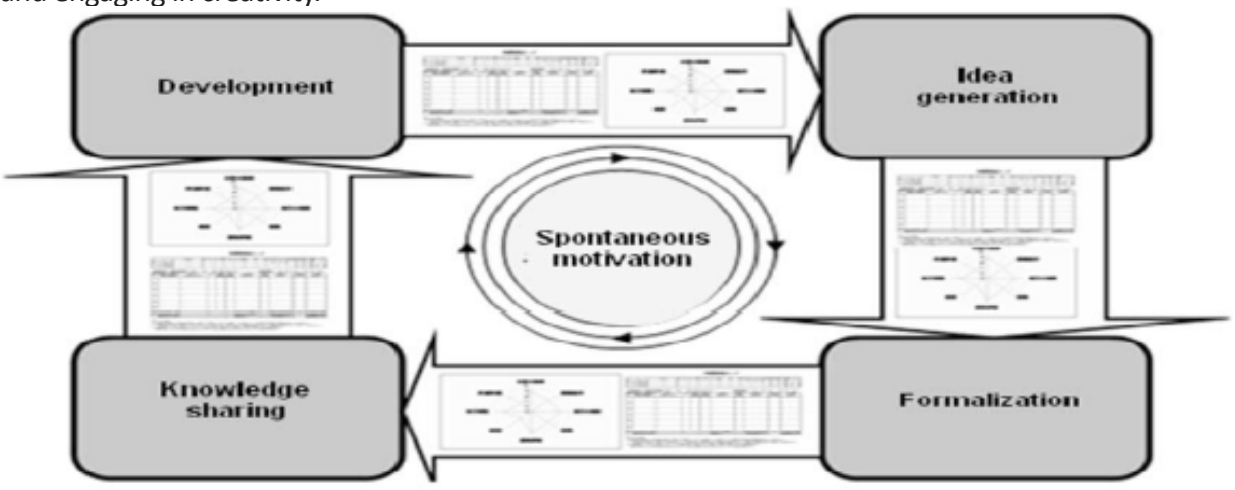

Figure 1 Knowledge Creation Process

4 Steps in the Process Model

4.1 The idea generation step

A space for creation is provided, promoting idea generation for R&D at the level of individual researchers by, for example, allowing both spontaneous and passive contact with others, and by stimulating communication. This also allows for both clarification of goals and extraction of researchers' tacit knowledge through conversational triggers.

Based on Locke's goal setting theory, an MBO goal management system is introduced as a motivation enhancement policy. Goal management sheets (Figure 2) are used at each step to set goals, evaluations of results are performed at the conclusion of each step, and researchers are given feedback.

This allows for recognition through goal accomplishment and feedback as per the motivational factors of Herzberg's motivational theory [7], allowing attainment of intrinsic motivation.

4.2 The Formalization Step

In this step, ideas retained at the individual level are shared at the team level, leading to the generation of further new ideas. Goal management sheets are used at the conclusion of the step, evaluations of results are performed, and researchers are given feedback. This allows for recognition through goal accomplishment and feedback as per the motivational factors of Herzberg's motivational theory, allowing attainment of intrinsic motivation.

Goal management sheets

	Name	Qualification grade	Department	Post	Goal setting day	evaluation entry day	sentation da
The subject appraisal							
The primary appraisal							
he secondary appraisal							

Results performance evaluation (Contribution evaluation)

	The target item	The setting of the achievement level	weight	level	Self valuatio	Self-comment	Boss evaluation	Boss comment	Results performance evaluation	Overall comment
1										
2										
3										
4										
5										
6										

Figure 2 Goal Management Sheets

4.3 The Knowledge Sharing Step

In this step, knowledge and ideas that were gained at the team level are analyzed, and ideas at the organizational level are accumulated, saved, and digitized. The knowledge and idea which were obtained on the team level are analyzed, and an idea is accumulated and saved on an organization level. It digitizes and a database (Figure 3) utilizable in the form which is easy to use in the spot of development is built.

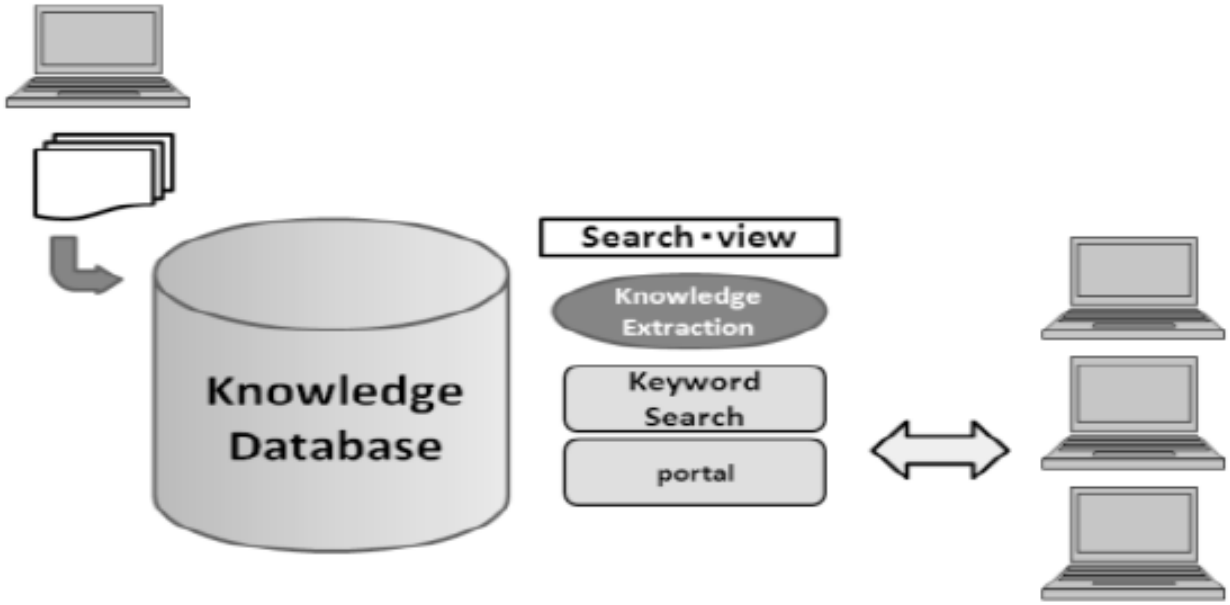

Figure 3 Knowledge Database

Formalized ideas as well as ideas from the individual level at the idea generation step should be actively collected. Accumulated ideas should also be collected into a portfolio (Figure 4) according to importance for business strategy and level of intellectual assets, and used when making cross-sectional decisions related to R&D.

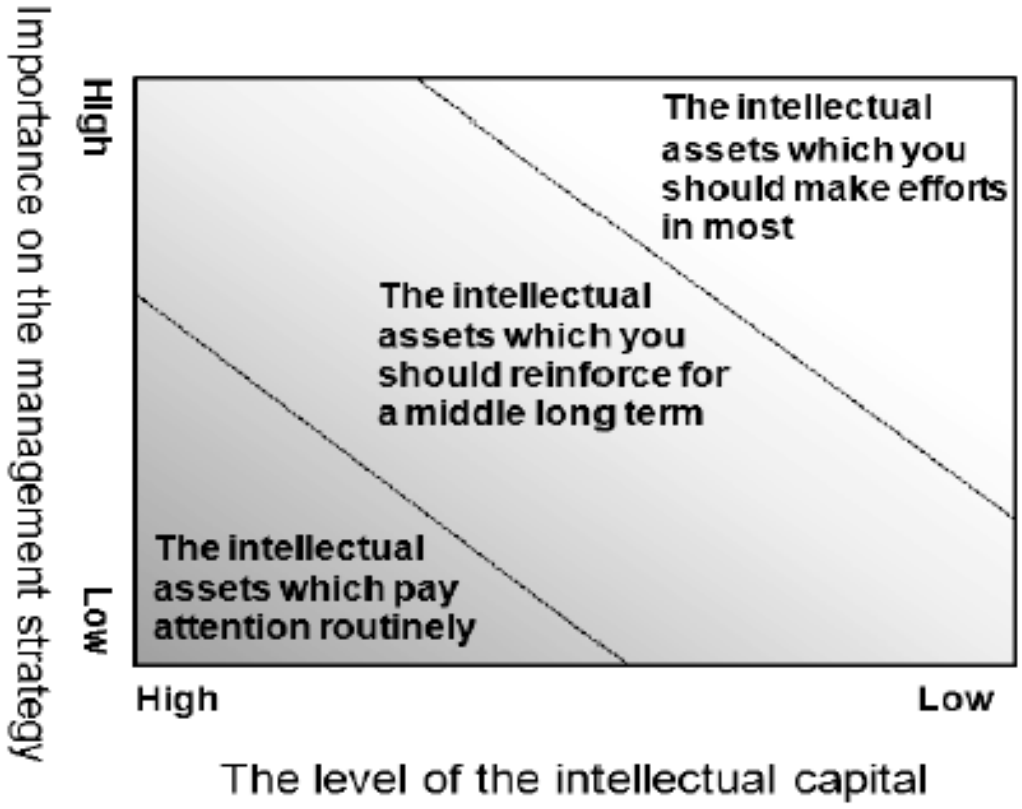

Figure 4 Portfolio

Goal management sheets are used at the conclusion of the step, evaluations of results are performed, and researchers are given feedback. This allows for recognition through goal accomplishment and feedback as per the motivational factors of Herzberg's motivational theory, allowing attainment of intrinsic motivation.

4.4 The development step

In this step, technology development is performed using decision-making based on the various ideas obtained in each of the previous steps, placing priority on items that require development. Finally, at the completion of development, goal management sheets are used to evaluate results and overall accomplishments, and feedback is given to researchers. This allows for recognition through goal accomplishment and feedback as per the motivational factors of Herzberg's motivational theory, allowing attainment of intrinsic motivation. Researchers then set new goals, and gain individual tacit knowledge through the technologies and experiences of each process. The idea generation step is then revisited, and new ideas for R&D are generated based on the experience and technologies are obtained as tacit knowledge.

5 Progress Management of MBO and Evaluation of Motivation

5.1 Progress management of MBO

Between each step, manage progress set goals by the researchers. A step is shown table 1.

There evaluate the progress of the target by steps. Improve progress toward the goal by creating a plan and goals.

Table 1 Progress Management

Step1	Check for each beginning goals set by the researchers
Step2	Hear from the researchers to determine whether progress remains the goal setting plan
Step3	If there is a goal is not be achieved, what can do to achieve, makes think the answer to researchers
Step4	The administrators have seen above grasped the situation, pointed out that researchers are not aware, they make them consider a countermeasure

5.2 Evaluation of motivation

In order to grasp the current motivation, motivation evaluation is performed. At the same time also, to visualize the difference between the motivation factors that have given researchers the motivation factors researchers and managers. Managers can understand the problems of management by visualization, is considered to be possible to create high-quality teaching and training plan. Figure 5 shows an example of the Evaluation of Motivation.

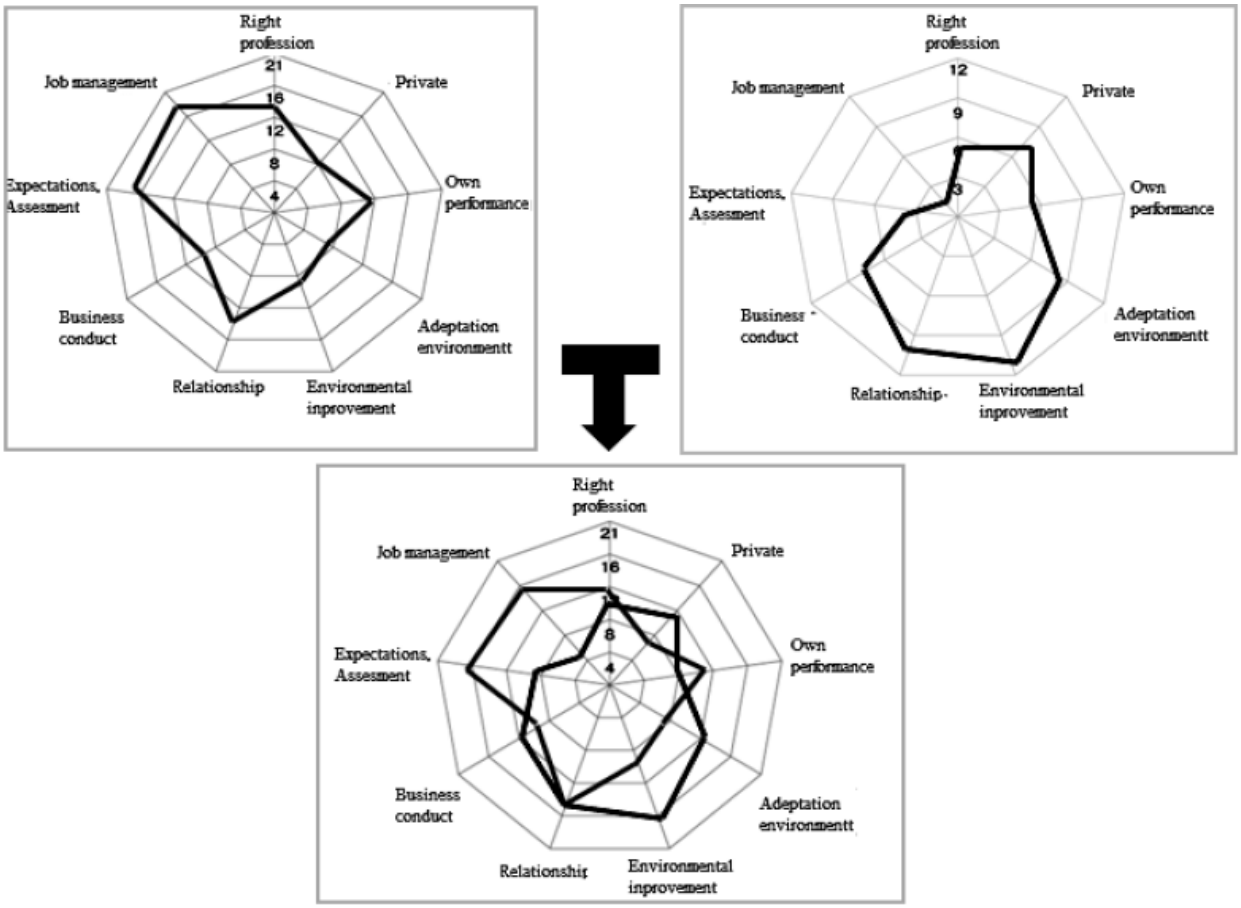

Figure 5 Example of the Evaluation of Motivation

6 Conclusions

We have proposed a process for creating knowledge through the application of a SECI process for knowledge management, as well as a process that incorporates policies for improving intrinsic motivation. In this process model, ideas are generated from individual researchers, collected at the team level, shared as a database, presented as a portfolio for decision-making related to development necessity, and development is then performed, allowing for effective creation of knowledge. At the same time, the incorporation of a goal appraisal system at each step is required for promoting the creativity that is necessary to support creating knowledge, while also increasing intrinsic motivation. The synergistic effect between these two features should lead to the creation of innovation of increased high quality.

Notes

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