# Relative Importance of Knowledge Portal Functionalities: A Contingent Approach on Knowledge Portal Design for R&D Teams

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## Abstract

*Many research and development (R&D) organizations and teams currently use a specialized knowledge portal (KP) for research collaboration and knowledge management. However, R&D organizations adopt whole portal functionalities without considering their R&D team or the team's task characteristics. The motivation of this study comes from this typical lack of consideration. This study proposes that the degree of importance of specific KP functionalities may be affected by the particular context in which R&D teams handle knowledge. The objectives of this research are to identify functionalities that are relatively important of KPs based on the specific team and the team's task characteristics. This research attempts to provide implications that can be used to design and implement KPs for R&D teams. Based on a field survey with 142 researchers in government-sponsored research organizations in Korea, we found that researchers perceive communication, collaboration, and connection functionalities as being important when their team sizes are large or their team members are distributed. Also, the coordination functionality is more important when the research type relates to commercialization projects than when the team is involved in basic-level research projects. We discuss interpretations of the results and implications on KP design.*

## I. Introduction

As the importance of utilizing knowledge resources increases and the amount of information and knowledge becomes overwhelming, adopting a Knowledge Portal (KP) has been one of the important issues for R&D organizations in the last decade [7]. Since many research organizations have been representing themselves as knowledge organization [22, 23], organizing the whole knowledge process and integrating diverse knowledge resources through a KP is crucial to the effectiveness of their R&D activities [3, 7].

Currently, R&D organizations use either a general or customized KP, or a set of general application systems such as basic messaging systems and document management systems for research collaboration and knowledge management (KM). These general KP applications, used in many business organizations, have focused on knowledge organization and integrating distributed knowledge. As a consequence, there are several studies that suggest R&D KPs reflecting the characteristics of the R&D process and of the R&D teams [3].

Applications and functions of KP have been considered universally appropriate and important to every situation and context. R&D organizations tend to only adopt all of the KP functionalities without considering their KM capabilities and team characteristics. The motivation of this study comes from this assumption. This study proposes that the importance of KP functionalities can be affected by the particular context in which R&D teams handle knowledge and interact with each other.

The objective of this study is to identify the most salient KP functionalities that will best facilitate R&D teams in their ability to share and distribute knowledge and its relationship with team and task characteristics. An empirical investigation has been performed with government-sponsored research organizations in Korea.

## II. Literature Review

### 2.1 Knowledge Management and Knowledge Portal

Facing knowledge-based competition, many organizations have recognized that managing knowledge is crucial for their competitiveness [11], and these organizations have tried to secure various types of knowledge assets. Recently, knowledge management has been considered as a means of maximizing the strategic value of organizations.

Organizational knowledge is created from individual experiences and learning in embedded routines such as business processes, tasks, domain-specific problem-solving activities, and organizational culture [17]. However, most of outcomes of individual experiences and learning remain as organizational members' tacit knowledge or in a pile of personal documents.

Von Krogh and Roos [24] noted that organizational knowledge resides both in the individual members and in the relations among organizational members, that is, in the social context. Sveiby [23] also considered transferring knowledge as the key activity in knowledge organizations. Thus, recently, firms are increasingly adopting interaction promoting strategies for KM such as online communities-of practices (CoPs).

Due to such social characteristics of organizational knowledge, KM supporting systems with collaboration functions such as KPs are considered as mandatory in order to manage organizational knowledge. With the effort of integrating distributed information and knowledge, and accessing diverse applications, the enterprise information portal (EIP) and EKP have gained popularity for providing users a single gateway to personalized information [20]. Though the terms of an enterprise portal, corporate portal, EIP, and (E)KP, which have subtle differences to their definitions, they are generally used interchangeably [10]. While other definitions related to EIP focused on information and application integration, and personalized gateways, a KP emphasizes knowledge organization. The following is the definition of EKP from Collins (2003, pp. 77): "[A] personalized interface to online resources for knowledge workers to organize and integrate applications and data. The solution (EKP) allows knowledge workers to access information, collaborate with each other, make decisions, and take action on a wide variety of business-related work processes regardless of the knowledge worker's location or business unit affiliation, the location of the information, or the format in which the information is stored."

**2.2 Functionalities of a Knowledge Portal**

Researchers have identified many key features of KP: coding and sharing of best practices, creation of corporate knowledge directories, and creation of knowledge networks [1]; collaboration and communities, content management, profiling and personalization, integration, presentation, and search [7]; knowledge portal, collaboration services, discovery services, a knowledge map, and knowledge repository [26]. Though authentication and security of information are important features of organization-wide information systems, we considered these features not as key functions but as basic infrastructure of KPs. From the reviews of these various features, we have classified them into seven functional categories as Table 1.

Many key features of a KP that have been identified by researchers belong to the contents category such as storage, structure and navigation, the knowledge map, and knowledge repository. Advanced content management technology and sophisticated retrieval techniques can be effective tools in enhancing knowledge organization and retrieving relevant knowledge [1].

[Table 1] Functional Categories of KP

| Category | Description |
|---|---|
| Communication | Supporting internal and external communication among members for sharing and transferring knowledge |
| Collaboration | Technologies are used for sharing ideas, sharing creation, and sharing a work space |
| Contents | Organizing and structuring knowledge to enhance its use and to guide users to available knowledge resources |
| Coordination | Maintaining consistency within a work product or managing dependencies between activities |
| Customization | Searching knowledge and delivery of more relevant knowledge to users |
| Community | Building and managing communities to activate communication and sharing among researchers |
| Connection | Creating and managing knowledge networks, and finding relevant experts |

Coordination activities, such as managing shared resources, segmenting and assigning tasks, and managing information flows, are required to maintain consistency within a project or to manage dependencies between activities to perform tasks [16]. Customization is composed of two main features: discovery services and personalization. Discovery services help users retrieve and browse knowledge in the knowledge repository [26]. Personalization of knowledge means filtered deliveries of knowledge based on a user profile for providing relevant knowledge to a user [2]. A community composed of a group of people who have similar interests and skills focuses on socializing and amplifying important knowledge and best practices in their interest areas [25]. Functionalities, such as finding relevant experts and managing experts' networks [26], for creating and managing knowledge networks are important for knowledge sharing and transferring between experts. The connections are central to the knowledge diffusion process because such networks enable individuals to locate the experts who have the knowledge that might help them solve a current problem and expose individuals to more new ideas [1].

### 2.3 R&D Team and Task Characteristics

There are a variety of factors that relate to team successes. These factors can be classified into two categories: task and team characteristics [4, 8, 21]. Task characteristics represent the nature of tasks performed by R&D teams. Thus, a number of task characteristics have been identified at the level of R&D teams such as task certainty, task interdependence, importance of the research project, research type, and project duration [8, 13].

Becerra-Fernandez and Sabherwal [4] provided a contingency theoretic view that the impact of a KM process on organizational performance is moderated by task characteristics in which knowledge is being used. These three task characteristics are examined in this study as influencing the perceived importance of KP functionalities: research type, project duration, and research importance.

**Research type:** For successful R&D projects, research activities and ways of performing activities are different as the type of research projects. The ways of communication that are critical to project success are different dependent on the research type [14]. For example, in the case of development projects, communication with other members of the company may be more important while communication with people outside might be more important in the case of basic research projects [14].

**Project duration:** Project duration can affect the probability of technical success in a project; the probability of technical success increases when the duration of the project increases [6]. Bizan [6] showed that as the size of the project increases – e.g., budget and duration – organizations tend to allocate better resources to the project.

**Research importance:** This factor implies recognition by the researchers of the importance of their project to their research field or their organization. Keller et al. [13] identified the fact that a climate of high work importance is associated with higher R&D team productivity.

Team characteristics represent the structure and culture of R&D teams. The structure of a team describes the organization of team members, the coordination mechanism, and performance appraisal system. Team culture includes cohesiveness of team members, team climate, research experience, and leadership types [8, 18, 19, 21]. The four team characteristics are examined in this study as factors that can have influence on the perceived importance of KP functionalities: team size, dispersion of members, cohesiveness of team, and research experience.

**Team size:** Because team size influences the amount of participation, the distribution of group members, and the probability that the group will achieve consensus, R&D team size is negatively related to team cohesiveness and team productivity [8]. According to Dailey [8], "the literature on groups broadly supports the negative effects of increasing team size on team cohesiveness, participative processes, and cooperation."

**Dispersion of members:** Dispersion of team members describes physical and organizational distance between researchers. As IT advances rapidly, physically distributed members can form a R&D team and also R&D teams can be composed of researchers who are from different R&D organizations.

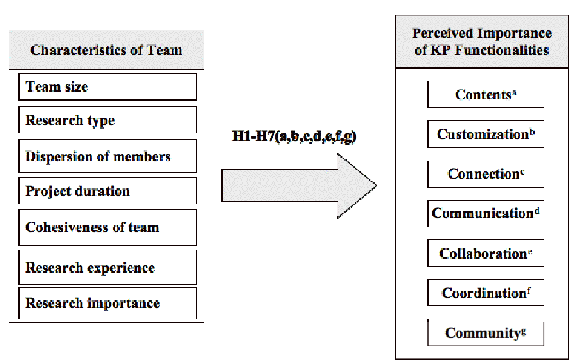
**Cohesiveness of team:** Cohesiveness reflects interpersonal interactions and attraction among team members. Dailey [8] saw cohesiveness as "the strength of the force acting on members to maintain group affiliation." One of the main advantages for promoting teamwork in R&D teams results from the nature of their tasks. In most cases, the complexity of the R&D task requires multiple skills and mutual interdependence [15]. In addition, team cohesiveness has positive relationships with a collaborative problem solving process and team productivity [8].

**Research experience:** The research experience factor describes the level of research experience in a team. R&D teams which have a higher level of experience in a domain may focus on more knowledge utilization rather than knowledge accumulation and organization because researchers have enough knowledge on a particular research domain [5]. Hence, the level of research experience is expected to influence researchers' IT usage behaviors and communication in their teams.

## III. Research Model and Hypotheses

The research model, which is presented in Figure 1, is about relationships between the perceived importance of KP functionalities, and team and task characteristics.

[Figure 1] Research Model on the Relationship between Task/Team Characteristics and the Importance of KP Functionalities



This model is devised from a conjecture that the perceived importance of KP functionalities is affected by the task and team characteristics. This has an assumption that high system quality such as KP level and KP form may increases user satisfaction, which ultimately leads to organizational performance [9, 12]. Concepts, constructs, and measures for the research models are summarized in Table 2.

[Table 2] Concepts, Constructs, and Measures

| Research constructs | Variables and Measure Description |
|---|---|
| Team Characteristics | |
| Team size | Number of team members |
| Dispersion of members | Locations and organizations of members |
| Cohesiveness of team | Consensus of team<br>team member relations |
| Research experience | Experience level of research fields |
| Task Characteristics | |
| Research type | Classification of Research (Basic/Application/Development/ Commercialization) |
| Project duration | Months devoted to research projects |
| Research importance | Research relevance<br>Fit to organizational core competence |
| Users' perception of importance of KP functionalities | Subjective evaluation of importance on KP functionalities (rated on a 1 to 5 scale) |

The hypotheses derived from the research model are that the perceived importance of each function is affected by the task and team characteristics. There are seven hypothesis groups (H1~H7) related with task and team characteristics. Each hypothesis group has seven sub-hypotheses corresponding to seven functional categories of KP as summarized in Table 3.

[Table 3] Research Hypotheses

| Hypothesis |
|---|
| H1: Perceived importance of each function is affected by **team size**.<br>H1a: Perceived importance of *contents* is affected by team size.<br>H1b: Perceived importance of *customization* is affected by team size.<br>H1c: Perceived importance of *connection* is affected by team size.<br>H1d: Perceived importance of *communication* is affected by team size.<br>H1e: Perceived importance of *collaboration* is affected by team size.<br>H1f: Perceived importance of *coordination* is affected by team size.<br>H1g: Perceived importance of *community* is affected by team size. |
| H2: Perceived importance of each function is affected by **research type**.<br>H3: Perceived importance of each function is affected by the **dispersion of members**.<br>H4: Perceived importance of each function is affected by **project duration**.<br>H5: Perceived importance of each function is affected by the **cohesiveness of team members**.<br>H6: Perceived importance of each function is affected by **research experience**.<br>H7: Perceived importance of each function is affected by **research importance**. |

## IV. Empirical Analysis

### 4.1 Research Method

#### 4.1.1 Sample and Data Collection

An empirical survey has been performed following the steps. Selecting target audiences was supported by Korea Research Institute of Standards and Science (KRISS), Korea Research Institute of Bioscience and Biotechnology (KRIBB), and other government-sponsored research organizations that allowed contact with their researchers and provided contact names and addresses of researchers.

From 211 distributed questionnaires, the survey yield complete data sets for 142 respondents after several were eliminated for incomplete data (69.7%). The distribution of respondents by their organizations and research domains are summarized in Table 4.

[Table 4] Distribution of Respondents

| Org. | # of Responders | Domain | # of Responders |
|---|---|---|---|
| A | 56 | Electronics & Telecommunications | 60 |
| B | 45 | Resources, Energy and Nuclear | 28 |
| C | 15 | Mechanics | 17 |
| D | 11 | Material Science | 14 |
| E | 9 | Biology and Bio Engineering | 13 |
| F | 6 | Environmental Science | 10 |
| Total | 142 | Total | 142 |

#### 4.1.2 Reliability of Measures

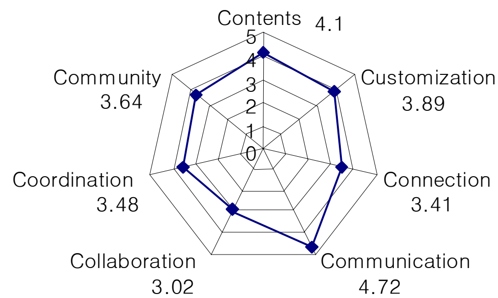
All the items of the survey, except the research type and dispersion of members, were measured by a five-point Likert type scale. The variables representing research type and dispersion of members are measured at the nominal level. Some research variables such as research importance are measured by multi-items, which are needed for reliability tests. The Cronbach's alpha values of those research variables were over 0.7 demonstrating the satisfactory reliability of the research variables.

### 4.2 **Results**

#### 4.2.1 Perceived Importance of KP Functions in R&D Organizations

As represented in Figure 3, the most important KP functionality in research projects is communication, followed by contents and customization. On the other hand, collaboration is the lowest in terms of importance among the seven categories regardless of the team characteristics.

[Figure 3] Perceived Importance of KP Functionalities




#### 4.2.2 Test of Hypotheses

Hypothesis groups from H1 to H7 of the first research model were tested by one-way ANOVA with the significant level of 0.05. Test statistics (F) and p-values of accepted hypotheses from the research model are summarized in Table 5. Test results of hypothesis groups, H1-H7, were classified into three categories. First, H1d and H1e were accepted. As the team size increased, communication and collaboration were perceived as more important. That is, communication and collaboration functions were considered important when R&D teams consisted of many members for executing research tasks. Second, H2f was accepted at the significant level of 0.05. Researchers of commercialization level projects, which applied basic and fundamental research outcomes to commercial products, thought that the coordination function was more important for performing project tasks than researchers on basic level research projects where they try to find theoretical solutions to logical or academic problems. Finally, both H3c and H3d were accepted. More distributed teams – i.e., members from different organizations and working at different places – perceive connection and communication as more important functions than other KP functional categories.

[Table 5] Accepted Hypotheses

| | Function | Test statistics (F-value) | p-value |
|---|---|---|---|
| Team size | Communication | 13.21 | 0.01 |
| | Collaboration | 9.552 | 0.04 |
| Research Type | Coordination | 9.497 | 0.05 |
| Dispersion of member | Connection | 12.04 | 0.02 |
| | Communication | 11.15 | 0.04 |

## V. Discussion & Conclusion

Out of the 7C (contents, customization, connection, communication, collaboration, coordination, and community), the most important KP functionality was found to be communication followed by contents regardless of the team characteristics. However, the variances of connection, communication, collaboration and coordination depended upon the team characteristics such as team size and dispersion of members. These results imply that the approach of designing a general KP may be different from that of planning a KP for R&D teams. Also, it is interesting that the functionalities of connection, communication, collaboration and coordination (that is, significant dependent variables in this study) all involve "user interaction" supporting functions of a KP, rather than working alone functions such as content or customization. This gives a hint that we need to concentrate on developing elaborate ways of encouraging R&D team members to actively interact when we design a KP for R&D teams. Consequently, in a R&D portal, effective management of interactions and collaboration among team members seems to be more crucial for KM success than that of knowledge or content itself. This, practically, may provide us future research motivation on how "social interaction related functionalities" such as CoPs can be embedded in a KP when we design and implement the KP.

The major finding is that perceived importance of KP functionalities is different by their task and team characteristics: First, as team size increases, communication and collaboration functionalities are perceived as more important than other functional categories. Since communication and collaboration can allow team members to meet more easily and help socialize knowledge between members, the importance of those two features is higher in large size teams than in smaller size teams.

Researchers who participated in commercialization level projects considered the coordination functionality as more important for performing project tasks than researchers involved with basic level research projects. From this result, we can infer that commercialization research involves more activities and more complex dependencies between activities than research on other types such as basic, application, and development research. Researchers have the needs of using the coordination functionality more often to coordinate activities, organize members, and maintain consistencies between activities within commercialization research.

When team members are dispersed physically and organizationally, connection and communication functionalities are perceived as more important than other KP functional categories. Since team members who are physically separated in dispersed teams and who come from other organizations do not know other members' expertise, where the experts are and how to communicate with them are important issues. On the result that dispersion of members affects neither collaboration nor coordination, we interpret the results that even in a distributed team, team members tend to coordinate and collaborate with others by face-to-face communication rather than IT tools. Although they use a KP for communication and connection, they might prefer face-to-face contact to a KP when they face complex research problems.

Therefore, for successful KP implementation and operation, managers should be able to assess the fit between research characteristics and KP functionalities before adoption of a KP. After KP implementation is completed, managers should consider research characteristics for configuring a KP and building a KM strategy to increase utilization of a KP and maximize benefits of KM [9, 12]. Finally, on the result that no independent variable influences any functionality of contents, customization, and community, we can explain to the following: First, contents and customization seem to be common and basic functionalities regardless of team characteristics. The possible evidence may be that the scores on the importance of contents and customization functionalities are all high. As for community functionality, since a R&D team is clearly divided into several sub-teams based on projects and the bonds of project members tend to be already strong, there could be no significant difference in the needs for community services by team characteristics.

This study has following limitations and future research directions. First, we assumed that the survey responders are knowledgeable in all the functions to be rated. Second, we did not consider stages of R&D process that might affect usage or importance of KP functions. An investigation on the effect of different stages of R&D process on KP functions is needed for the future research. Finally, more relevant characteristics of R&D teams such as organizational support factors, trust or leadership may be added to improve the understanding of the perceived importance of KP functionalities.

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