The Adoption Model of Institutional Repositories: Which Constructs Attract Scientists to Share Their Research Outputs?

기관리포지터리 수용모형 연구: 과학분야 연구자를 중심으로

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ABSTRACT

The purpose of this study is to develop an adoptive model of institutional repositories (IRs) by identifying the key factors affecting adoptive intention of IRs and explaining the relations among these factors. Through a survey of 270 researchers and 12 in-depth interviews in the field of physics, mathematics, and life science in Korea, performance expectancy, perceived risks, socio-organizational influence, and individual characteristics were found to have substantial influences on the adoptive intention of IRs. Among the key factors, individual characteristics showed the greatest effect on the adoptive intention of IRs, followed by performance expectancy and other socio-organizational influences except for the perceived risks. Strategies to enhance the adoptive intention of IRs based on analyses of the results were suggested, in terms of the reformation of research assessment system at the national level, strengthening of role of the operational institution, and the need for voluntary scientists-participating service.

초 록

본 연구의 목적은 과학분야 연구자를 대상으로 기관리포지터리 수용에 영향을 미치는 요인들을 도출하고 이들 요인들간의 관계를 규명함으로써 기관리포지터리 수용모형을 개발하는 것이다. 270명의 물리수학분야와 생명과학분야 연구자들이 응답한 설문조사와 12명의 심층면담 내용 분석 결과, 개인의 심리적 특성이 기관리포지터리 수용의도에 가장 높은 영향을 미치는 것으로 나타났다. 그 다음은 성과기대, 사회조직적 영향 순으로 확인되었으나, 인지된 위험은 유의한 영향을 주지 못하는 것으로 검증되었다. 기관리포지터리 수용의도 향상을 위한 전략으로 국가주도적 제도 개선 방안과 운영 기관의 역할강화 및 홍보 방안, 그리고 연구자의 참여유도형 서비스방안을 제언하였다.

Keywords: institutional repository, knowledge sharing, open access, unified theory of acceptance and use of technology (UTAUT), adoption model
기관리포지터리, 지식공유, 오픈액세스, 통합기술수용이론, 수용모델

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1. Introduction

When a researcher submits a copyright transfer agreement to a publisher, the rights on distribution of the work become vested in the publisher upon publication. In accordance with such a custom, a researcher should always review the copyright policies of the publisher regarding free online access of his/her academic paper on the internet. Many researchers have shown discontent with this system, and since the early 2000s have been publishing in open access journals or presenting their papers online for free on repositories operated by the institutions to which they belong as alternative methods of publication. In the case of Korea, since the Korea Advanced Institute of Science and Technology (KAIST) started developing and operating the KAIST Open Access Self-Archiving System (KOASAS) repository in 2007, Seoul National University and others have voluntarily operated IRs. Further, in 2009, the Open Access Korea (OAK) project began, and a Korean open access repository was developed using MIT's Dspace software. Korea has encouraged the sharing and spreading of academic research outputs by providing this OAK repository to major domestic research institutions for free (Ministry of Culture, Sports and Tourism, Bureau of Library and Museum Policy Planning, 2017). In spite of national and systematical supports, only 33 open access IRs operated in Korea are registered on the Directory of Open Access Repositories (University of Nottingham, 2017). As tools that enable the free use and sharing of research outputs with everyone in the world, IRs are innovations of scholarly communications. However, considering the level of supply of IRs up until now, it seems difficult to say that researchers, who are the creators and users of information, agree with the act of sharing information through IRs.

Therefore, the purpose of this study is to identify factors that affect scientists' adoption of IRs, examine the relationships between these factors, and develop an adoption model of IRs. Through a literature review and preliminary interviews, an adoption model was developed that shows these factors affecting IRs and knowledge sharing factors based on the UTAUT model. Questionnaires were distributed to 270 researchers in the fields of physics, mathematics, and life science. This study targeted scientists who were aware of sharing scholarly outputs and actively sharing their information through ArXiv. The model was reconfirmed through in-depth interviews with 12 scientific researchers in Korea, the hypotheses were verified with structural equation modeling (SEM), and the adoption model was verified with the results of the questionnaire and the in-depth interviews.

2. Literature review

2.1 Institutional repositories and knowledge sharing

IRs are systems developed for the purposes of collecting and maintaining the knowledge of researchers who belong to specific institutions, and

freely sharing and spreading that knowledge around the world. IRs are similar to knowledge management systems in that they are systems operated by institutions in accordance with their visions and purposes. The "adoption" of IRs, the subject matter of this study, could be operationally defined as the act of allowing free sharing of one's research output on an online repository operated by the researcher's institution. We have therefore examined advanced research on the use and non-use of IRs, as well as the factors that affect knowledge sharing.

Various factors of use and non-use have been established through previous studies on IRs. Motivational factors to open access IRs included the increase of visibility, reputation or career (Cresser et al., 2010; Rowlands, Nicholas, & Huntington, 2004; Watson 2007; Fry et al., 2009), trustworthiness of contents (Fry et al., 2009; Cresser et al., 2010; Theodorou, 2010), various service functionalities of IRs (Foster & Gibbons, 2005; Watson, 2007; Fry et al., 2009), academic rewards (Kankanhalli et al., 2005; Cresser et al., 2010; J. Kim, 2010), research impact (Watson, 2007; Cresser et al., 2010), rapid dissemination (Lawal, 2002; Watson, 2007), and trustworthiness of IR systems (Foster & Gibbons, 2005). The barriers against the adoption of IRs found the copyright issues (Watson, 2007; Cresser et al., 2010), additional time and effort (Watson, 2007; J. Kim, 2010), and plagiarism (Harley et al., 2007; Watson, 2007; Fry et al., 2009). Socio-organizational factor to open access IRs identified social norms (Swan & Brown, 2005; Sanchez-Tarrago & Fernandez-Molina, 2010), institutional policy (Cresser et al., 2010; Theodorou, 2010), and mandates (Sanchez-Tarrago & Fernandez-Molina, 2010; Pinfield et al., 2014; Björk et al., 2014). Factors that affect knowledge sharing could also be seen in individual psychological characteristics. Specifically, such factors include enjoying altruism (Hew & Hara, 2007; Cho, Chen, & Chung, 2010; Kankanhalli et al., 2005; J. Kim, 2010), sense of belonging, generalized reciprocity (Wasko & Faraj, 2005; Cho, Chen, & Chung, 2010), and knowledge self-efficacy (Hew & Hara, 2007; Cho, Chen, & Chung, 2010). However, Cabrera and Cabrera (2005) identified obstacles to knowledge sharing factors such as personal reputation, promotion, egoism in the organization, and lack of a perception of sharing. Furthermore, Cho, Chen, Chung (2010) found that altruism is positively related to attitudes toward knowledge sharing, an intrinsic motivator, but reputation is insignificant as an extrinsic factor. In particular, they revealed that the sense of belonging, a social-relational factor, had an indirect effect on the knowledge sharing intentions.

2.2 UTAUT in open access adoption environment

To develop the basic research framework of this study, the unified theory of acceptance and use of technology (UTAUT) model was selected. The UTAUT, a newly developed model based on eight existing theoretical models from such fields as sociology, psychology, and information technology, explains up to 70% of the variance in technology acceptance behavioral intention (Venkatesh et al., 2003). Moreover, the validity of the adoption of the new system as

an innovative model was examined. The UTAUT, which was selected in order to identify the factors that affect IRs operated by scientific institutions, did so by adopting IRs as a new technology to voluntarily share scientists' knowledge and to develop an adoption model. In the UTAUT, the four following direct determinants affect the behavioral intention and use behavior: performance expectancy, effort expectancy, social influence, and facilitating conditions (Venkatesh et al., 2003).

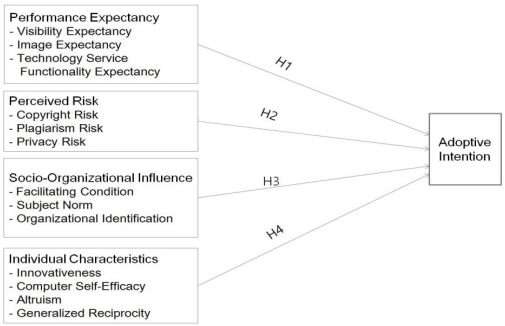
The UTAUT model has been used in recent studies on open access and digital library service areas, and its relevance has been verified. Some researches such as the study on an adoption model of IRs based on open access by Singeh, Abrizah, Karim (2013) did not show significant effects of performance expectancy, effort expectancy, social influence, or facilitating conditions on adoptive intention. However, using binary logistic regression, Dulle and Majanja (2011) developed and verified the open access adoption model by applying the UTAUT model. They found that performance expectancy, effort expectancy, attitude, and awareness of open access are the key determinants in the researchers' adoptive intentions of open access journals, and analyzed that age, awareness, behavioral intention, facilitating conditions, and social influence significantly affect researchers' actual usage (Dulle & Majanja, 2011).

Tibenderana et al. (2010) applied a modified UTAUT model for the acceptance of hybrid library services. Instead of effort expectancy, they developed the service oriented unified theory of acceptance and use of technology (SOUTAUT) research model, adding the two constructs of relevance of e-library services and the expected benefits rather than effort expectancy. Schaper and Pervan (2007) verified statistically that effort expectancy is difficult to use as a reliable construct for showing the degree of actual usage. Through in-depth interviews, they showed that social influence had a strong effect on the acceptance of information technology. Self-efficacy and altruism were identified as significantly effective variables among individual characteristics. In addition, Maldonado et al. (2011) applied the UTAUT model in their study on e-learning motivation and educational portal acceptance, and found that e-learning motivation and social influence had an effect on use behavior and actual usage. Wang et al. (2010) initiated a study based on the UTAUT model on the acceptance of distance learning services and found that performance expectancy, effort expectancy, social influence, and facilitating conditions all had a positive influence on teachers' intention of using distance learning. Martin and Herrero (2012) also applied the UTAUT model in their study of the service usage of hotel reservation websites. The results of this study showed that performance expectancy and effort expectancy affected the service user intention, and that the innovativeness construct had a moderating effect on the relationship between performance expectancy and online purchase intention (Martin & Herrero, 2012). This study was meaningful because it showed that individuals' psychological factors affect their intentions to adopt new information technologies.

3. Hypotheses and research model

In previous studies, various factors that affect the use and non-use of IRs and knowledge sharing have been identified. This study aimed to comprehensively examine the factors that affect the adoption of IRs based on scientific researchers. In addition, through preliminary interviews with six scientists, including three professors and three postdoctoral researchers, this study proposed a Korean integrative research model to explain the adoptive intention of IRs by reconfirming and examining the relationship between such factors.

As Figure 1 shows, the relationship between factors such as perceived expectancy, perceived risks, socio-organizational influence, and individual characteristics and the adoptive intention of IRs were established.



〈Figure 1〉 The architecture of the IR adoption research model

3.1 Performance expectancy and adoptive intention

Performance expectancy is defined as the extent to which the usage of IRs helps improve one's performance. Performance expectancy has been verified as the first factor of the UTAUT that affects behavioral intention (Venkatesh et al., 2003). The significant effect of performance expectancy on adoptive intention has been verified in various studies: Schaper and Pervan (2007) proved that performance expectancy had a significant effect on the adoptive intention of Australian occupational therapists for a new system, and Dulle (2010) substantiated that performance expectancy had a significant effect on adoptive intention using a UTAUT-based adoption model for open access.

Moreover, three key sub-factors of performance expectancy have been identified in research: visibility expectancy, image expectancy, and technology service functionality expectancy. First of all, the expectation that the visibility of their research papers would be increased was identified to be a representative factor for performance expectancy (Lynch, 2003; Foster & Gibbons, 2005; Swan & Brown, 2005; Jones, Andrew, & MacColl, 2006; Park, 2007; Watson, 2007; Fry et al., 2009; Cresser et al., 2010; Cullen & Chawner, 2011). Second, image expectancy is the expectation that researchers would improve their image as a result of open access to their research output. Willinsky (2010) showed that open access improved the academic reputation of researchers by providing them more publicity from critics. Kim (2008) verified that academic reputation was a key factor recognized by faculties in shelf-archiving, and Park (2007) verified that the perceived reputation as a sub-factor of perceived authoritative advantage

had a significant effect on open access journal publishing. TAM2 (Venkatesh & Davis, 2000, p. 189) and Moore and Benbasat (1991, p. 195) stated that as long as innovation helps improve social status and image, individuals will take advantage of innovative procedures. Ram (1987, p. 211) also stated that when an individual believes that his or her reputation will improve through the adoption of innovation, individual resistance against innovation will decrease.

The third sub-factor of performance expectancy is technology service functionality expectancy (SFE). There has been no significant evidence of the causal relationship between various service functionalities provided by IRs and adoptive intention of researchers in previous works. However, one study focused on the service functionality of a library website on users' intention to use (Heinrichs et al., 2007), and through interviews this study identified that researchers wanted practical support for their research and scientific authoring activities (Swan & Brown, 2004, 2005; Foster & Gibbons, 2005). Based on such results, this study concluded that IRs would be adopted if they provided functions to satisfy the needs of researchers, such as e-portfolio services, search engine exposure services, popularity reporting services (Foster & Gibbons, 2005), open access journal publishing services (Bankier & Perciali, 2008), or long-term archiving services (Bates et al., 2006; Harley et al., 2007; Hockx-Yu, 2006).

During the preliminary interviews for this study, special requests by scientists were investigated. Many noted that they would appreciate the recommendation of similar research papers by linking with social network services (SNSs) such as twitter and facebook. Scientists also expressed the desire to connect with the university's research output evaluation system, research management system, a duplicative submission prevention system via Korea Research Information (KRI), and commonly used DBs such as ResearcherID and Mendeley. Therefore, this study categorized performance expectancy perceived by scientists into visibility expectancy, image expectancy, and technology service functionality expectancy, and hypothesized that performance expectancy has a positive effect on scientists' adoptive intention of IRs.

Hypothesis 1:
Performance expectancy (visibility expectancy, image expectancy, and technology service functionality expectancy) has a positive effect on scientists' adoptive intention of institutional repositories.

3.2 Perceived risks and adoptive intention

Perceived risks are concepts that cause anxiety in an individual regarding the adoption of innovations (Roger, 2003), and overall people tend to resist new or uncertain things as they do not want to change traditions (Sheth, 1981, p. 276; Ram, 1987, p. 209). According to preliminary interviews with scientists in Korea, in most cases, librarians or laboratory assistants mediated the submission of research output to IRs on behalf of the authors. Therefore, scholars were not likely to perceive any inconvenience regard-

ing the use of IRs. Considering the preliminary interviews and the domestic operation environment of IRs, effort expectancy (one of the key factors in the UTAUT model) would not be a relevant factor to measure the convenience of system usage. Countries whose IRs are at the early stage of development, internal complexities among stakeholders such as awareness of copyright infringements, plagiarism, and invasion of privacy are to be considered before external factors such as the actual usage of the system or the interface.

In previous studies, the fear of copyright infringement and plagiarism is considered as an anxiety over open access through IRs (Harley et al., 2007; Jones, Andrew, & MacColl, 2006; Kim, 2007). Moreover, individuals who worry that the openness of their private information might cause adverse results and illegal use were more likely to abstain from involvement in information sharing (Dinev & Hart, 2004). Individual researchers, however, not only open their research outputs to the public, but also such information as their names, departments, and subjects of interests on the researcher page of the IRs. With the development of internet information technology, individuals become aware that their activities are monitored and collected (Cranor, Reagle, & Ackerman, 2000). In this regard, some researchers have found that the consideration of openness of privacy primarily affects the adoptive intention of information systems. The openness of personal information had a direct effect on the intent of acceptance of U-Commerce and a personal medical record system (Sheng et al., 2008; Angst & Agarwal, 2009). It was reported that clients who were using personal profiles had a greater perception of risk of compromising privacy than those not using profiles on SNSs such as Facebook (Fogel & Nehmad, 2009). This shows that users who share information via the internet are more aware of the risk of privacy invasion. Dinev and Hart (2005) found that concerns of internet privacy negatively affect information-seeking activities on the internet. Therefore, this study selected perceived risks as key factors instead of effort expectancy, which was utilized in the UTAUT model. Perceived risks are composed of copyright risks, plagiarism risks, and privacy risks, and this study hypothesized that perceived risks have a negative effect on scientists' adoptive intention of IRs.

Hypothesis 2:
Perceived risk (copyright risk, plagiarism risk, and privacy risk) has a negative effect on scientists' adoptive intention of institutional repositories.

3.3 Socio-organizational influence and adoptive intention

As IRs are strategic implementation models for information sharing, the adoption of IRs would be difficult without the active participation and cooperation of scientists for the sharing of their own research output. Key factors of the UTAUT include social influence and facilitating conditions (Venkatesh et al., 2003). Subjective norms were identified as factors that represent social influence in the related works of knowledge sharing and open access (Kankanhalli

et al., 2005; Swan & Brown, 2005). Subjective norms had a stronger impact on potential users who did not have any knowledge on or belief in a new system (Hartwick & Barki, 1994). Fishbein and Ajzen (1975) defined a subjective norm as the awareness of a reference group's impact on individual's behaviors, and established subjective norms as a key factor of behavioral intention in their study. Facilitating conditions show a relationship with the use behavior exclusively (Venkatesh et al., 2003). Facilitating conditions are seen as non-volitional factors, which could not directly explain behavioral intention (Venkatesh et al., 2008, p. 485). However, several research studies have shown that facilitating conditions are significant in relation to adoptive intention of information systems or information services (Chang & Cheung, 2001; Wang et al., 2010). Previous studies supported that facilitating conditions could have a significant effect on adoptive intention. Therefore, this study hypothesized that facilitating conditions could affect adoptive intention.

Moreover, organizational identification is a concept of closeness and the sense of belonging to a certain organization, and previous literature has shown that individuals with stronger organizational identification are more likely to accept a new system or service provided by their institutions (Wasko & Faraj, 2005; Kankanhalli et al., 2005; Cho, Chen, & Chung, 2010). Hekman et al. (2009) examined whether organizational identification and professional identification had an effect on professional doctors, and their research results showed that even a professional group's adoption of services is highly affected by the organizational identification factor. Therefore, the current study strengthened socio-organizational influence by adding the organizational identification factor to the other key factors of the UTAUT model (social influence and facilitating conditions). An IR is an information-sharing system operated by the organization to which the researcher belongs, and so a researcher cannot be exempt from the policies of the IRs that he or she works for.

Hypothesis 3:
Socio-organizational influence (facilitating condition, subjective norm, and organizational identification) has a positive effect on scientists' adoptive intention of institutional repositories.

3.4 Individual characteristics and adoptive intention

Through a literature review on the adoption of information and technology, individual psychological characters have been verified as some of the main factors that influence the adoptive intention of new technology (Agarwal & Prasad, 1998; Yi, Fiedler, & Park, 2006). Some of the main psychological characteristics that affect the adoption of new information technology are innovativeness and computer self-efficacy. Such characteristics were proposed by Roger (2003) as the representative attributes of individuals who most progressively accepted innovations (Roger, 2003, p. 267-299). Ram (1987) noted that if an individual is not aware of the necessity of innovation and does not discover adoptive intention, that individual would

resist innovations. Innovativeness of individuals was recognized as important for the acceptance of new information technology or information services (Hirschman, 1980; Agarwal & Prasad, 1998; Kim et al., 2009; Arts, Frambach, & Bijmolt, 2011; Verdegem & De Marez, 2011).

Moreover, computer self-efficacy was shown to be a main factor of the adoptive intention of new information and technology systems (Bandura, 1997; Chou & Chen, 2009; Lai, 2009). In the case of computer self-efficacy, however, previous literature has revealed its direct effects on adoptive intention (Chou & Chen, 2009), as well as indirect effects (Lai, 2009). Bandura (1997) found that individuals with lower computer self-efficacy tend to resist trying new strategies and give up easily, while individuals with higher computer self-efficacy tend to be more progressive in adopting changes.

In addition, according to research on open access and information sharing, it was found that individuals with stronger characteristics of altruism and generalized reciprocity tend to be more active in sharing information. During preliminary interviews, it was confirmed that altruism and generalized reciprocity were important factors. Hung, Lai, and Chang (2011) analyzed that altruism is not only the main precedence factor for ease of use, but also a factor that directly affects the intention to use. Kankanhalli et al. (2005) noted that altruism is a factor that affects contribution of knowledge, and Kim (2008, p. 168-171) remarked that altruistic characteristics of professors are the only factor that significantly affects academic information sharing. Cho, Chen, Chung (2010) explained that altruistic characteristics as a mediating factor is a psychological factor that affects the intention to use for information sharing. Those who actively participated in mutual community perceived reciprocity as a moral obligation or social pressure, and wanted to contribute their knowledge as a public good. Wasko and Faraj (2000) showed that an awareness of reciprocity, or the perception of knowledge sharing as an ethical responsibility, is the main factor that affects the intention to share information. Individuals who believed that knowledge sharing was fair and reciprocal desired to contribute to knowledge sharing (Huber, 2001).

There are, however, other contrary research outputs that show that reciprocity does not have a significant effect on information sharing (Wasko & Faraj, 2005; Lin et al., 2009; Hung, Lai, & Chan, 2011). Wasko and Faraj (2005) found that direct reciprocity did not have a significant effect on knowledge contribution in electronic networks. Overall, this study concluded that generalized reciprocity, in which sharing knowledge with a third party is allowed, has a significant effect. In this regard, it seems that individual psychological characteristics such as innovativeness, computer self-efficacy, altruism, and generalized reciprocity would positively affect the adoptive intention of IRs.

Hypothesis 4:
Individual characteristics (innovativeness, computer self-efficacy, altruism, and generalized reciprocity) have a positive effect on scientists' adoptive intention of institutional repositories.

4. Research methodology

4.1 Sample and data collection

To prove the variables that affect adoptive intention, this study performed statistical analysis. In-depth interviews were conducted in order to qualitatively confirm the factors that affect the adoptive intention as analyzed in the questionnaires, and to complement the research outputs. The study targeted domestic scientists working at institutions operating IRs. The detail subjects were limited to physics, mathematics, and biology, as well as medical services and medical science within the area of life sciences, all of which had been actively sharing information from their fields through ArXiv. The subjects were limited in order to examine researchers in areas that were aware of open access, considering the fact that Korea's IRs are still in the beginning stages of developments.

As of March 2013, according to statistics from the OAK portal (http://www.oak.go.kr/), there were 26 open access-based IRs in Korea, and scientists in the fields of physics, mathematics, and bio-sciences were only present in 12 institutions: 6 universities and 6 research institutions. The professors and researchers who belonged to these institutions were sampled. The sampling of the professor group and the sampling of the researcher group differed in method. University professors were classified into full professors, associate professors, assistant professors, research professors, and lecturers. All participants were selected as targets of questionnaires after their names, phone numbers, email addresses, and addresses on university websites were gathered. The targets were selected in this way in order to show the difference between full professors with life tenure and associate professors and below who were highly interested in the active spreading and sharing of their research outputs, as these were related to their promotion, rehiring, and research funding grants. In total, there were 386 survey-eligible professors in Korea.

In the case of researchers, the purpose of this study and the subject areas were explained to the officers who were in charge of operating the IRs, and they were asked to distribute the questionnaires evenly among professional researchers of different genders, ages, professions, assignments, and experience levels in using IRs. Researchers were limited to those who held regular positions such as senior researchers, researchers, and junior researchers. In order to avoid bias toward the institutions with relatively more researchers, a total of 50 survey questionnaires were distributed to those disciplines with more than 100 scientists, and a total of 30 copies were distributed to the disciplines with less than 100 scientists. The number of researchers identified was approximately 1,000 according to IR-operating librarians. Thus, the total number of relevant professors and researchers was about 1,386, and in order to even out the number of targets, 386 university professors and 340 researchers (close to a 1:1 ratio) for a total of 726 respondents were selected.

Although there is no absolute standard for the sample size, the current study based its sample size on the guidelines proposed by Hair et al. (2006), which state that if there are five or less latent variables

and three or less observed variables, more than 200 samples are necessary. Thus, in order to minimize potential errors of this research, the target sample size was set at 200 or more. From April 15 to May 26, 2013, written and online questionnaires were conducted. Researchers were encouraged to participate in the questionnaires at least three times through emails, phone calls, and regular mail. From among 762 questionnaires administered, a total of 322 surveys were returned from respondents (162 mail surveys and 160 web-based surveys). There were 270 valid respondents (35.43% of the sample size) after excluding cases that were impossible to use as a part of the statistical calculations. Small incentives were provided to all of the respondents for the completeness of their responses and for improving the response rate.

Of the respondents, 74 individuals (27.4%) were in the fields of physics and mathematics, while 196 individuals (72.6%) were in the life sciences. There were 154 respondents (57.0%) who had information sharing experience as opposed to 116 respondents (43.0%) who did not. Only 54 respondents (20.0%) replied that their information was open to the public through IRs, which confirmed that the adoption of IRs in Korea was in the early stages. In addition, 107 respondents (39.6%) knew that IRs were used, whereas 163 (60.4%) were not aware of the existence of an IR in their organization. This reflects practical problems such as a lack of public relations efforts on the part of those who run IRs and a lack of awareness among researchers.

Regarding profession, 130 respondents (48.0%) were professors, 129 (47.8%) were researchers, and the remaining 11 (4.2%) were others. Regarding age group, 122 respondents (45.2%) were in their 30s or younger; 98 (36.3%) were in their 40s; and 50 (18.5%) were in their 50s and older. Of respondents, 187 (69.3%) were male and 83 (30.7%) were female, which is a result of the fact that there are traditionally more male than female professionals in Korea.

In order to qualitatively identify the factors affecting the adoptive intention and to supplement the research results, in-depth interviews were conducted in the following manner. Interview requests were sent to the sample group by email and phone calls, and 12 respondents who chose to participate were interviewed directly (face-to-face) or indirectly (by phone). All of the respondents were researchers who had experience in using IRs: two in the medical field, one in the field of physics, four in biology, four in mathematics, and one from physics-mathematics. According to the guideline of Lincoln and Guba (1985, p. 234-235), an analysis of at least 12 in-depth interviews would provide an optimal outcome without duplicated information. In-depth interviews were recorded, and each lasted at least 60 minutes.

4.2 Measurements

The items in the questionnaire were structured on the theoretical basis of previous literature on open access and information sharing, and reflected the preliminary interviews of domestic researchers in science. Content validity was achieved by two professors and two researchers in physics and life sciences, which were the target fields in this survey. One

professor had a Ph.D. in library and information science, and another professor had a Ph.D. in statistics. Incorrect or ambiguous items were amended through the pilot study.

A Likert scale was used for the items, to which respondents scored one point for “strongly disagree” and five points for “strongly agree,” except for the socio-demographic items of the respondents and the questions regarding the IR-user context. There were a total of 77 questions: 8 on the background of this study, 60 questions on 14 variables, and 9 socio-demographic questions. These items included three open-ended questions and one rating question. Reliability and validity tests were conducted for the variables measured by plural items to analyze the research model, and the variables were then calculated into a mean value of observed variables to be analyzed.

5. Data analysis and results

This research performed hypothesis testing using SEM. In the first stage, SPSS 21.0 was used to summarize the characteristics of the collected data and to analyze the reliability of each variable and the descriptive statistics values of the measurement items. Table 1 represents the mean, standard deviation, skewness, and kurtosis of the observed variables used in this research model. Each variable was measured through multiple questions, and item parceling was utilized in the analysis considering the ratio of the sampling size and the parameter estimates, as well as the normality of the data. Some research results have verified that modeling analysis through item parceling contributes to increasing the goodness-of-fit of the model compared to an analysis of individual items (Bandalos, 2002; Cho & Kang, 2007). As shown in Table 1, by examining descriptive statistics values of the observed variables, the means of each scale showed a minimum of 3.10 to a maximum 4.10, with a standard deviation ranging from 0.69 to 1.01. The variable that showed the highest mean was visibility expectancy at 4.10, but the skewness and kurtosis of the visibility expectancy were 1.59 and -1.05, respectively. Therefore, the measured values were spread out around the mean value, showing a distribution that was skewed to the right. In addition, the skewness of the technology service functionality expectancy was also 1.95, showing a distribution skewed to the right as well. Other than these two observed variables, all of the variables showed skewness and kurtosis values between +1 and -1. Hence, these appeared to satisfy the hypotheses of a normal distribution.

Moreover, in order to confirm the validity of experimental measures of each variable, this study reviewed the basic structure through exploratory factor analysis. Validity is defined as the degree to which an experimental measure adequately shows the real meaning of the concept under consideration (Babbie, 2007, p. 146). For the exploratory factor analysis, principle component analysis (PCA) and the orthogonal rotation technique of the VariMax rotation method were each used to extract the method of factor in the analysis and the method of factor rotation. Based on the guideline of Hair et al. (2006, p. 128), which

〈Table 1〉 The analysis of descriptive statistics on variables (N=270)

Latent variable	Observed variable	Mean	SD	Skewness	Kurtosis
Performance Expectancy	Visibility Expectancy (VE)	4.10	0.80	1.59	-1.05
	Image Expectancy (IE)	3.61	0.83	0.28	-0.38
	Technology Service Functionality Expectancy (SFE)	3.90	0.69	1.95	-0.98
Perceived Risk	Copyright Risk (CR)	3.99	0.88	0.61	-0.91
	Plagiarism Risk (PL)	3.56	1.01	-0.40	-0.40
	Privacy Risk (PR)	3.14	0.93	-0.10	-0.33
Socio-Organizational Influence	Facilitating condition (FC)	3.31	0.77	0.01	-0.32
	Subjective norm (SN)	3.10	0.80	0.32	-0.10
	Organizational Identification (OI)	3.83	0.75	0.53	-0.51
Individual Characteristics	Innovativeness (INV)	3.35	0.84	-0.45	-0.04
	Computer self-efficacy (SE)	3.49	0.78	0.22	-0.15
	Altruism (AL)	3.86	0.78	-0.09	-0.31
	Generalized Reciprocity (RE)	3.87	0.77	0.29	-0.42
Adoptive Intention		3.63	0.81	0.52	-0.56

states that when the factor loading is 0.4 or higher it is considered to be a significant variable, this study set the factor loading at 0.5 or higher. Further, this study excluded question items that multi-load onto other sub-factors with a factor loading of 0.5 or more, as well as those that did not meet the standard for sub-factors.

As a result of factor analysis of the performance expectancy, image expectancy, visibility expectancy, and Technology Service Functionality Expectancy were extracted. These three factors explained 62.988% of the total number of items, and the factor loading value for each factor was 0.586~0.836. For perceived risks, three factors were extracted: privacy risk, copyright risk, and plagiarism risk. These factors explained 70.888% of the items, and the factor loading value was 0.733~0.871. To perform factor loading for socio-organizational influence, facilitating condition, organizational identification, and subjective norm were extracted. These three factors explained 69.087% of the items, and the factor loading value was 0.638~0.885. To perform factor loading for individual characteristics, the four factors of innovativeness, computer self-efficacy, generalized reciprocity, and altruism were extracted, and these factors explained 78.772% of the items. The factor loading value was 0.706~0.898. The factor analysis for adoptive intention extracted one factor, and the factor loading value was 0.897~0.918. Thus, as a result of evaluating the validity of the 57 items for 13 selected factors and the dependent variable adoptive intention through an exploratory factor analysis, this study analyzed 52 final question items.

In addition, to analyze the reliability of experimental measures, this study employed the Cronbach's alpha correlation coefficient, which measures internal item consistency reliability to examine the reliability of the scales. The reliability of performance expectancy

was determined to be 0.916; perceived risk 0.779; socio-organizational influence 0.821; individual characteristics 0.885; and adoptive intention value 0.891. Considering that the Cronbach's alpha correlation coefficient is 0.70 or higher, all values showed reliability, with the exception of plagiarism risk at 0.694. According to Nunnally (1978, p. 245-246), a Cronbach's alpha correlation coefficient of 0.70 or higher would "suffice," while 0.60 or higher is "acceptable."

In the second phase of testing, AMOS v.20.0 was used to test the goodness-of-fit and validity of the measurement model, and maximum likelihood estimation (MLE) was used as an estimation method for the parameters. In this study, the goodness-of-fit of the measurement model was evaluated with the Chi-square, goodness-of-fit index (GFI), normed fit index (NFI), non-normed fit index (NNFI), comparative fit index (CFI), root-mean-square residual (SRMR), and root mean square error of approximation (RMSEA). Many researchers have noted that the Chi-square statistics is sensitive to large sample sizes, and since the Q (Chi-square/*df*) value adjusting the Chi-square statistics was 3.0 or lower, the model was considered to have a good fit (Hair et al., 2006, p. 748; G. Kim, 2010, p. 125).

The results of examining the goodness-of-fit of the measurement model with the collected data are as follows: GFI was 0.910, CFI was 0.931, NNFI was 0.911 (higher than 0.90), RMR was 0.043 (less than 0.05), SRMR was 0.0628 (less than 0.08), and RMSEA was 0.068 (less than 0.08). However, the value of NFI was 0.883, which was less than 0.90, and was therefore inappropriate. As the research model was inappropriate, we measured the standardized coefficient between the observed variables and latent variables. The organizational identification (OI) variable not only showed a low standardized coefficient (β=0.079), but the t-value (t=B/S.E.) was 1.209, which was far below the threshold ($t \geqq 1.965$, $p=0.227>0.05$). The OI appeared to be invalid in the research model, and as a result, OI was excluded and the modification model was tested. The goodness-of-fit index is shown below on Table 2. GFI, CFI, NFI, and NNFI all appeared to be 0.90 or higher, and RMR was determined to be 0.039, which was less than 0.05. Finally, with both SRMR (0.0551) and RMSEA (0.067) at less than 0.08, these fit indices indicated a good model fit.

Since the goodness-of-fit of the model was appropriate, this study formed a structural model according to hypotheses by assessing construct reliability, convergent validity, and discriminant validity. The testing of model validity is usually assessed using the convergent validity and discriminant validity of the observed variables (Fornell & Larcher, 1981; Hair et al., 2006). In order to measure the convergent validity, the size of the standardized loading estimates, average variance extracted (AVE), and construct reliability were analyzed (Hair et al., 2006). For convergent validity to exist, standardized loading estimates should be at a minimum of 0.50 or higher, and ideally 0.70 or higher. The t-value should also be 1.965 or higher (Hair et al., 2006). The AVE was calculated as the mean variance extracted for the factor loading on a latent construct. An AVE of 0.50 or higher indicated an adequate convergence.

〈Table 2〉 Goodness-of-fit index for the modification model (n=270)

Fit indicators	Results	Recommended value	Suggested by authors
χ^2/df	2.207	$\chi^2/df \leqq 3.0$	Hong 2000; Hair et al. 2006
GFI	0.921	≧ 0.90	Hong 2000; Hair et al. 2006
RMR	0.039	≦ 0.05	Hair et al. 2006
SRMR	0.0551	≦ 0.08	Hair et al. 2006
RMSEA	0.067	〈0.05 (close fit) 〈0.08 (reasonable fit)	Browne and Cudeck 1993
NFI	0.900	≧ 0.90	Hair et al. 2006; G. Kim 2010
NNFI (TLI)	0.924	≧0.90	Hair et al. 2006; G. Kim 2010
CFI	0.942	≧ 0.90	Hair et al. 2006; G. Kim 2010

Further, the construct reliability denoted the shared variance among the observed variables when measuring a single latent variable.

Table 3 shows the verified results of estimates for the modification model. Copyright risk (CP, β=0.353), facilitating condition (FC, β =0.467), and innovativeness (INV, β =0.321) were not able to reach the standard (≧0.5). However, they were still included in the validity analysis as they were considered important for the analysis of factors affecting the adoption of IRs as an innovative system.

In accordance with the guideline by Fornell and Larcker (1981), this study verified whether the AVE is larger than the sum of standardized factor loading

〈Table 3〉 Structural parameter estimates for the modification model (N=270)

Latent variable	Observed variable	B	S.E.	β	t-value	P
Performance Expectancy	x1 (VE)	1.000	Fix	0.780		
	x2 (IE)	1.047	0.097	0.788	10.801	0.000
	x3 (SFE)	0.631	0.074	0.575	8.508	0.000
Perceived Risk	x4 (CP)	1.000	Fix	0.353		
	x5 (PL)	2.332	0.498	0.724	4.688	0.000
	x6 (PR)	2.159	0.461	0.727	4.687	0.000
Socio-Organizational Influence	x7 (FC)	1.000	Fix	0.467		
	x8 (SN)	2.151	0.414	0.963	5.194	0.000
Individual Characteristics	x10 (INV)	1.000	Fix	0.321		
	x11 (SE)	1.625	0.346	0.565	4.694	0.000
	x12 (AL)	2.342	0.461	0.807	5.077	0.000
	x13 (RE)	2.524	0.491	0.890	5.137	0.000
Adoptive Intention	y1 (AI1)	1.000	Fix	0.850		
	y2 (AI2)	1.038	0.059	0.863	17.514	0.000
	y3 (AI3)	1.035	0.061	0.845	16.970	0.000

Note: VE (Visibility Expectancy), IE (Image Expectancy), SFE (Technology Service Functionality Expectancy), CP (Copyright Risk), PL (Plagiarism Risk), PR (Privacy Risk), FC (Facilitating Condition), SN (Subjective Norm), INV (Innovativeness), SE (Computer Self-efficacy), AL (Altruism), RE (Generalized Reciprocity), AI (Adoptive Intention)

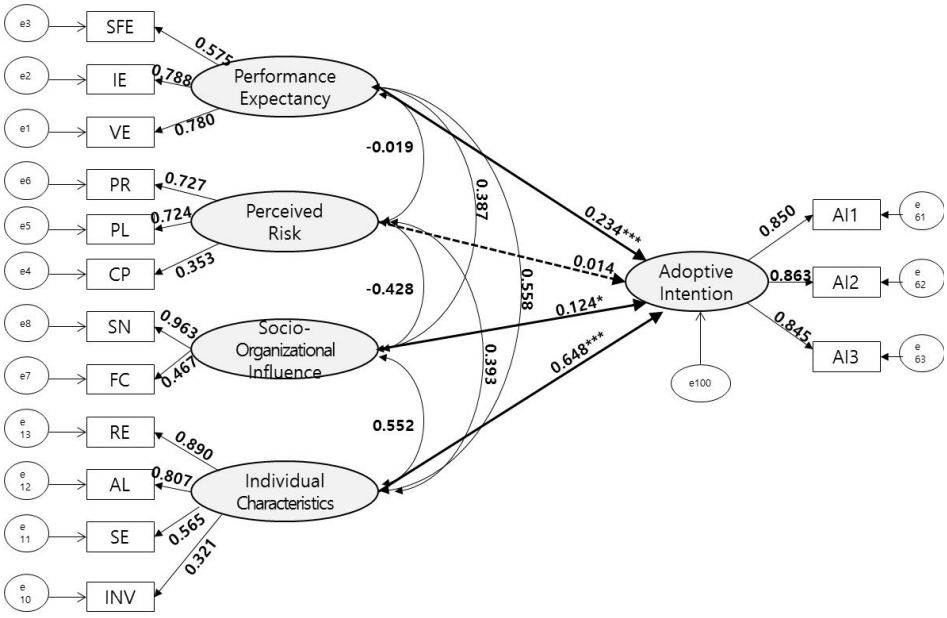
squared for assessing discriminant validity. The results of the discriminant validity test showed that the AVE values were all larger than the squared correlation coefficient (r^2), supporting the discriminant validity. AVE was 0.50 or higher and the CR 0.70 or higher, therefore, these results supported the convergent validity of the adoptive intention of the IRs (Refer to <Table 4>).

The third phase of this study verified the research hypotheses through path analysis of structural equation of the structural model. The path analysis test results are shown in Figure 2. Except for the perceived

〈Table 4〉 The correlation matrix of the adoption of IRs

Latent variables	1	2	3	4	5	CR
1. Performance Expectancy	**(0.683)**	0.000	0.150	0.311	0.413	0.864
2. Perceived Risk	-0.019	**(0.606)**	0.183	0.154	0.089	0.810
3. Socio-Organizational Influence	0.387	-0.428	**(0.846)**	0.305	0.343	0.907
4. Individual Characteristics	0.558	-0.393	0.552	**(0.799)**	0.709	0.934
5. Adoptive Intention	0.643	-0.298	0.586	0.842	**(0.769)**	0.909

Note: **Values below the diagonal** are correlation estimates among latent variables, **diagonal elements** are AVE, and **values above the diagonal** are squared correlations.



〈Figure 2〉 Standardized path estimates for the adoption of IR structural model

Note 1: **Line**: Statistically significant path **Dotted line**: Statistically non-significant path

Note 2: VE (Visibility Expectancy), IE (Image Expectancy), SFE (Technology Service Functionality Expectancy), CP (Copyright Risk), PL (Plagiarism Risk), PR (Privacy Risk), FC (Facilitating Condition), SN (Subjective Norm), INV (Innovativeness), SE (Computer Self-efficacy), AL (Altruism), RE (Generalized Reciprocity), AI (Adoptive Intention)

*p<0.05, ***p<0.001

risks and the path coefficient (β=0.014, t=0.220, p=0.826), all of the paths in the modified research model were significant. More specifically, performance expectancy (β=0.234), socio-organizational influence (β=0.124), and individual characteristics (β=0.648) were shown to have a significant effect on the adoptive intention. Among all these variables, individual characteristics had the strongest impact on adoptive intention, and the exploratory power of performance expectancy, socio-organizational influence, and individual characteristics for adoptive intention appeared to be 76.2 percent. Korean scientists showed stronger intention to adopt IRs as individual characteristics, performance expectancy, and socio-organizational influence are higher. Therefore, hypotheses 1, 3, and 4 were supported, while hypothesis 2 was rejected.

6. Discussion and implications

6.1 Performance expectancy

In the study, performance expectancy was operationally defined as the degree of an individual's belief in the attainment of a research performance goal when using the IRs operated by the institution to which he or she belongs. As a result, hypothesis 1 — "performance expectancy (β=0.234, t=3.432, p<0.05) had a positive effect on scientists' adoptive intention of institutional repositories" — was selected. Among three observed variables, image expectancy (β=0.788, SMC=0.621) showed the highest explanation power, followed by visibility expectancy (β=0.780, SMC=0.608) and technology service functionality expectancy (β=0.575, SMC=0.330). However, in contrast with the survey results, participants in the in-depth interviews said they did not think IRs would increase the awareness and reputation of scientists. Participants said that publishing a paper in conventional renowned journals would help increase the individual's academic reputation, awareness, and image promotion, while repositories were merely supplementary.

In many cases, domestic research outputs are quantitatively evaluated, such as by the number of SCI journal papers the researchers publish. Thus, it could be inferred that the Korean researchers consider publishing papers in renowned journals to be the most valuable and meaningful priority. On the other hand, some agreed with the promotional effects of scientists' e-portfolios provided by IRs, as opening the individual's scholarly information would lead to publicized impact worldwide. These scientists recognized that the only way to receive acknowledgment of their academic profession and accomplishments is by publishing a paper in authorized journals, and considered other functions, such as the e-portfolios of the IRs, to be merely supplementary. However, scientists who had experience with submitting to ArXiv expected that sharing would not only be limited to official publications, but that gray literature would also be accepted as individuals' achievements and would help to promote their image. In addition, some hoped that IRs would help manage and preserve their research outputs and promote their achievements.

In summary, if IRs were to become reliable and renowned archives such as ArXiv, scientists would voluntarily participate in the movement.

Visibility expectancy is an essential element of the adoption of IRs as well as for encouragement of participants in the open access movement. Scientists wish to expose their scholarly articles so that their research ideas will be acknowledged. If IRs could satisfy these fundamental needs of researchers, this would positively affect the adoptive intention.

> I think it is a natural process to share one's own academic information. Common researchers, excluding those who work for (prestigious or large) universities don't easily get access to papers they want because they have to pay for them. This shows that information doesn't circulate properly. Publishers want to do business with copyrights, which deprive ordinary people of the chances to obtain information. (ID 05)

The most preferred service functionality was an increase in exposure through search engines (202, 13.13%), followed by connection of their other outputs submitted to subjective repositories such as ArXiv or Pubmed Central (197, 12.80%), the use and citation statistics reports (196, 12.74%), bibliographical support tools like RefWorks or EndNote (188, 12.22%), a long-term preservation of contents (187, 12.15%), and automatic submission connected to an internal research assessment system (181, 11.76%). It was confirmed that e-portfolio services, which enable managing researchers' careers and promote research outputs, are not much preferred (147, 9.55%). Regarded as a new service model of scholarly communication in literature reviews, publishing open access journals (i.e., publishing publications of the lab that the researchers belong to) were not acknowledged by Korean scientists according to the low number of respondents (139, 9.03%).

The results of surveys and in-depth interviews proved that perceived performance expectancy has a significant effect on the adoptive intention. This study analyzed performance expectancy based on visibility expectancy, image expectancy, and technology service functionality expectancy. Further, this study discovered an additional performance expectancy in in-depth interviews. This was the performance expectancy that IRs would improve the institutional image and reputation rather than those of individuals, and that social contribution would occur through knowledge sharing. From the results, building trust in the value of the IRs seems to affect the adoptive intention. Moreover, researchers were more interested in abundant experimental research environments and capable researchers rather than their image or reputation. It seemed they would voluntarily adopt IRs if they could receive more research funds through their increased visibility and image by using the IRs. In this way, capable researchers would be attracted.

6.2 Perceived risks

Perceived risks are used as a concept of barriers against the adoption of innovation (Sheth, 1981; Ram, 1987, p. 209). This study operationally defined per-

ceived risks as the scientists' degree of belief in possible risks involved in opening their scholarly information to the public through IRs. In the survey results, hypothesis 2 – "perceived risk (β=0.014, t=0.220, p>0.05) had a negative effect on scientists' adoptive intention of institutional repositories" – was rejected due to an insignificant result. Testing the standardized coefficient and SMC value of the sub-factors of perceived risks – copyright risks, plagiarism risks, and privacy risks – revealed the relationship between the factor and sub-factors. The privacy risks (β=0.727, SMC=0.528), plagiarism risks (β=0.724, SMC=0.525), and copyright risks (β=0.353, SMC=0.125) explained perceived risks by 52.8%, 52.5%, and 12.5%, respectively. The result of the copyright risk analysis showed the lowest explanation power but differed from previous studies (Swan & Brown, 2005; Harley et al., 2007; Jones, Andrew, & MacColl, 2006; Watson, 2007; Cresser et al., 2010; Kim, 2011). This result was reflected in in-depth interviews as well. Most of the researchers expressed the opinion that their research outputs should be opened to the public for free rather than asserting their copyrights. They were strongly against copyright transfers to publishers, and they were of the opinion that institutions or government agencies need to mediate conflicts with publishers. The most explainable sub-factor was privacy risks: scientists felt that there are risks of privacy invasion when their scholarly information is openly accessed on the internet. The explanation power of the privacy risks appeared the same as the previous studies, showing that individuals with higher concern about privacy were more likely to abstain from involvement in information sharing (Dinev & Hart, 2004).

The next-highest explanation power was shown by plagiarism risks. The perception of plagiarism risks appeared on a similar level as in in-depth interviews. Specifically, scientists had different opinions on the material types that should be open. For example, scientists were concerned that if gray literature such as seminar presentation files was open, their ongoing research ideas could be plagiarized. In this case, the scientists were worried that the research in process would not be able to be protected.

> I am worried the most about the exposure of research ideas in process. For example, we study which changes in genes are followed by cancers. It takes 3 to 10 years to complete the research and announce the paper. On average, it takes 4 to 5 years. If the on-going research items and data are open to those doing the similar experiments, or they are not secured by patents, people can use those materials for their project. This would bring about perplexing disputes and problems. (ID 06)

The result showed that based on interviews, the Korean scientists had very high perceptions of the risks involved in committing plagiarism.

> About plagiarism, security systems have been working on a national level since the case of Hwang, Woo-sheok. All professors may be very careful with plagiarism. In spite of that, I am

> still anxious about the possibility that my research ideas can be copied when they are shared. I am worried about the research idea theft occurring if study plans are open. (ID 06)

Meanwhile, there was another opinion that if research outputs are not open, a more serious problem could arise. When a dispute arises on copyrights or plagiarism, the one whose scholarly product is publicly opened first would win in court. The scientists recognize that their research idea could be protected by openness. This could be a major motivator of the revitalization of open access.

> I don't feel anxious about the danger of information sharing. Rather, it would be more problematic when it is not shared. When it is not open, an issue of copyright or plagiarism can get more serious. When shared, amateurs may take the information, but professionals would never do such a thing. (ID 11)

6.3 Socio-organizational influence

The notion of socio-organizational influence was operationally defined as the combination of factors affecting the adoptive intentions of the IR operated by the researchers' affiliating organizations. Two factors were the social influences coming from the colleagues in the same academic fields and organizational influences from the affiliating organizations. In the result, hypothesis 3 – "socio-organizational influence (β=0.124, t=2.039, $p<0.05$) had a positive effect on scientists' adoptive intention of institutional repositories" – was selected because of a significant result. By testing relations among the factor and the sub-factors – facilitating condition, subjective norm, and organizational identification – higher subjective norm (β=0.963, SMC=0.928) and facilitating condition (β=0.467, SMC=0.218) were linked to increasing socio-organizational influence. The explanation powers of subjective norm and facilitating condition were 92.8% and 21.8%, respectively.

Previous literature has verified that subjective norms had a great impact on adoptive intentions (Quinn, 2010; Tibenderana et al., 2010; Kim, 2011). This study reconfirmed the result of previous studies showing that subjective norm had the highest explanation power of socio-organizational influence. Scholarly achievements are validated by writing research ideas, submitting manuscripts, and being acknowledged by peer review processes. It was a reasonable result that subjective norm showed to be the most effective among socio-organizational influences in academia, where acknowledgement from peer researchers is emphasized.

On the other hand, one interviewee pointed out that a quantitative and uniform assessment system of research performance was one of the barriers to scholarly information share and free use. Scientists in Korea should submit their research achievement to an assessment system in order to appraise research performance or win government research funds. The items to be acknowledged are mostly quantitative, like the number of SCI papers or patent applications. The registered research outputs of an individual scien-

tist were used in the evaluation of universities and institutions. Scientists working for a university or institution had no other option but to control research performance in order to carry out appraisals on an annual basis. In such an environment, it seems difficult for Korean scientists to see the value of sharing research outputs via IRs.

In addition, although facilitating conditions (β=0.467, SMC=0.218) had lower explanation power than subjective norm, there were several positive opinions about the facilitating conditions during the interviews. The scientists expressed that they would follow the policies of scholarly information sharing if institutions were to implement such policies. Scientists also expressed that if institutions provided related education or instruction to use IRs, this would have positive effects on the use of the IR. The interview results confirmed that policies and technical supports of the organization would positively influence the adoptive intention.

However, OI was eliminated because the factor showed an insignificant result in the verification of the initial measurement model by testing SEM. OI showed a significant effect on the adoption of knowledge management systems or blogs, but showed an insignificant result in this study. In the in-depth interviews, the participants responded that their decisions were not related to institutional preference or a sense of closeness to the institution. There were many opinions that an individual scientist is a producer of research output, along with the person in charge of the quality of the output. The sense of closeness or belonging did not affect the openness of scholarly information by individuals, because research should be performed independently regardless of the organization.

6.4 Individual characteristics

This study considered the IR as an innovation of scholarly communication. In addition, individual characteristics operationally comprised innovativeness and computer self-efficacy, which affected the acceptance of innovative system and altruism, and generalized reciprocity, which affected information sharing. Hypothesis 4 — "individual characteristics (β=0.648, t=4.486, p<0.05) had a positive effect on scientists' adoptive intention of institutional repositories" — was selected because of a significant result. As a result, generalized reciprocity (β=0.890, SMC=0.793) showed the highest explanation power followed by altruism (β=0.807, SMC=0.652), computer self-efficacy (β=0.565, SMC=0.319), and innovativeness (β=0.321, SMC=0.103).

The result of the lowest explanation power of innovation was seen in the in-depth interviews as well. Scientists considered using IRs as another duty assigned by the institution rather than an innovative system for scholarly information sharing. However, the research result that generalized reciprocity with highest explanation power was identical to the result of previous studies that the factor had a significant impact on information sharing (Harley et al., 2007; Kim, 2008). Generalized reciprocity, emphasized by Wasko and Faraj (2005), was statistically verified as the major effective factor to the adoptive intention

of IRs in this study.

It was reconfirmed that scientists were highly aware of generalized reciprocity in both questionnaires and interviews. Faculty and researcher groups belonging to universities or institutions recognized themselves as social opinion leaders. Thus, it was confirmed that they thought they should return benefits as much as they receive them by opening their own scholarly information for reuse in accordance with generalized reciprocity. If governments and institutions offered education and the advocacy of open access to scientists, then the adoptive intention would rise.

> The opportunity to be able to study itself is a blessed one from the society. I believe that I have to pay back as much as I have received from the society. Above all, the research supported by the government must be shared without conditions. In the case of (business) projects partially funded by the government or corporations, the funding institution should guarantee the time to commercialize. And then, the research results can be open. (ID 06)

In addition, computer self-efficacy and altruism were verified as significant factors of the adoptive intention of IRs. Computer self-efficacy is defined as the degree to which an individual believes in his/her ability to fulfill specific missions in the future (Compeau & Higgins, 1995). Professionals were aware that they would be able to fulfill a specific mission of information sharing if the institution operated a new system with the policies of open access, such as IRs.

Altruism is behavior carried out to benefit others without anticipation of social rewards (Macaulay & Berkowitz, 1970, p. 3). This study is meaningful in that it verified altruism of Korean scientists as influencing the adoptive intention of IRs. Such a result shows that Korean scientists recognize that an IR is a system of information sharing. Indeed, it seems that Korean scientists hope to help other scientists' research by sharing their own scholarly information free of charge. Therefore, it would be necessary for the government to put strategic efforts into an advocacy group of scientists for open access.

6.5 Adoptive intention

Adoptive intention was defined as the degree to which an individual intended or planned to perform some activities or use specific services in the future (Venkatesh et al., 2003). This study operationally defined adoptive intention as the degree to which scientists positively regarded the willingness to submit and permission to share their research outputs to IRs, as well as the degree to which they would recommend their colleagues to participate. The following statements about the adoptive intention were measured using of 5-point Likert scale: "It is desirable for the affiliation to carry forth scholarly information openly, and to share it free of charge with its community members," "I will submit and allow my scholarly information to be open by my institution," and "I intend to recommend sharing scholarly information to my colleagues by using my institution's IR." As

a result, the first statement showed the highest average score, followed by the second and the third.

The research results showed that the scientists have positive intentions to be involved in the policies of open access suggested by institutions, and such policies are fundamentally desirable. Moreover, the above-average score on the question about researchers' intention to recommend the IRs to their coworkers reconfirmed that the research groups were highly influenced by subjective norms. In addition, the scientists were aware that they should follow the policies if institutions carry forward with open access policies. They principally agreed to open their scholarly information, since the scholarly papers were the products for acknowledgement of his/her own research idea and had traditionally been published in journals. In particular, papers funded by national grants should be made open. It seems that institutions should develop policies to encourage the participation of institutional members and promote open access policies through educational activities.

> Most of my studies have been supported by taxes. As for the nation-funded projects, sharing the results is natural. (ID 05)

> I will open information not just to the school I work for but also academic institutions and government organizations if they request so. Researchers generally want to take pride in their research results and be acknowledged for them. I will share information as long as there aren't any troubles related to technology industrialization and security. (ID 07)

7. Conclusions

This research is the first study to develop the theoretical model on the adoptive intention of IRs in the scientific and academic communication environment of Korea. The adoption model proposed by this study is a modified UTAUT model that considers the innovativeness of IRs, individual characteristics of scientists, and organizational influence. This study has its limits in that it was conducted on researchers in physics, mathematics, and life science, which are fields with a high awareness of open access. However, this study statistically verified performance expectancy, perceived risks, socio-organizational influence, and individual characteristics in addition to their sub-factors, and qualitatively confirmed the researchers' adoptive intention in the Korean research environment through in-depth interviews.

The key to enhancing the adoptive intention of IRs is to enable IRs to induce the voluntary participation and active cooperation of researchers, who are the producers and users of academic research outputs. For such purposes, it is integral to motivate the researchers to adopt the IRs and to foster the appropriate structural and cultural conditions in Korean society. Performance expectancy, perceived risks, socio-organizational influence, and individual characteristics are complexly interconnected. By comprehensively reviewing such factors, it is possible to propose the following strategies: the reformation

of the research assessment system at the national level, the strengthening of roles of the operational institution, and the need for voluntary scientists-participating service.

First, the reformation of the research assessment system at the national level is as follows. It is necessary for the government to improve quantitative evaluation systems, such as the number of SCI journal papers or the number of patent applications. Government agencies should develop qualitative evaluative indicators to measure activities such as knowledge sharing and the social contribution of knowledge. In in-depth interviews, scientists acknowledge that the sharing of scholarly achievements is a social contribution, and they expressed a moral obligation to return the benefits they received from society. This awareness of generalized reciprocity was the most explainable factor in the adoption of IRs. Moreover, it would be necessary to create a social atmosphere for information sharing by codifying policies and laws that regulate information sharing, especially with research outputs produced with government research funds.

Secondly, it was found that the organizational support and the proper functioning of the IR-operating institutions were very important. Accordingly, it is essential to develop of a dedicated team in charge of operating an IR at each institution so that researchers recognize that the infrastructure of the operational institutions is well supported. Facilitating conditions, a sub-factor of socio-organizational influence, affects the adoption of IRs, and in in-depth interviews, researchers stated that they would voluntarily adopt the IRs if they were supported and operated by the institutions that they belong to. In addition, it would be necessary to closely cooperate with internal functional departments, such as IT centers, education and training divisions, research offices, and libraries, which are needed for managing research outputs. If the departments are competitive or do not interact, there may be difficulties in carrying the IR operation forward.

As shown in surveys and in-depth interviews, researchers had little understanding of the necessity and value of IRs. Therefore, the need for IRs should be communicated to and acknowledged by the members in charge of IR operation. Moreover, open access policies should be promoted to the researchers who are the members of certain institutions through various means of communication. One way to induce participation would be to consider granting awards to researchers who are active users of IRs.

Third, as a means of service to consider the individual characteristics of individuals and the performance expectancy through the adoption of IRs, services in which scientists voluntarily participate, services considering observability, and services emphasizing relative advantages such as long-term preservation of IRs, free trial services to use IRs, or use contests should all be conducted in order to provide trialability. It was confirmed through in-depth interviews that researchers who have used IRs intend to adopt IRs more positively than the researchers who have not. Furthermore, considering that IRs cannot collect all types of information produced in universities and research centers, it would be necessary

to consider services focused on key contents. A service in which scientists voluntarily participate can take the example of the Q&A sections of F1000Prime and ResearchGate, which provide reviews of articles by leading scholars of life science. This would be a service that considers the altruism and reciprocity of researchers.

As the survey results showed the highest explanation power for subjective norm (β = .963), the researchers of academic communities have very strong subjective norms. Therefore, the recommendations of influential scholars would help enhance the adoptive intention of IRs. In particular, ResearchGate operates a Q&A section where 3 million scientists worldwide voluntarily participate, share their research outputs, and ask and answer questions. This service considers the altruistic characteristics of a knowledge contributor. IRs would have to prepare an opportunity for knowledge contributors to feel a sense of pleasure through helping others, and to be appreciated for the help they have contributed.

According to Roger (2003), observability refers to the degree to which the results of an innovation are visible to others. In the survey results, scientists replied that exposure to search engines is the primary preferred function to be provided by IRs, followed by link services to subject-based archives and a statistics report service showing the citation rate and usage of individuals' scholarly content. As indicated, researchers expect that as their research outputs become exposed on the internet as much as possible, the usage of their research outputs would increase. For such purposes, e-portfolio services should be considered in order to supplement the functions exposed for IR contents and to promote researchers. Through the literature review and in-depth interviews, it was confirmed that researchers want to collaborate with other researchers. Organizations should design the IR's interface to advertise the institution and to connect knowledgeable professionals so that the network can promote "know-who" from "know-how." In this regard, as leaders of such change, the government, organizations, and operators should put forward multidirectional efforts in terms of policies and services in order to further the open access movement.

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[Appendix] Survey Instrument

Visibility Expectancy

- Disseminating research output by an author's institutional repository allows his or her output to become more easily accessible because it is free and without access limitations.
- Disseminating research output in an author's institutional repository increases the potential readership of the author's research output.
- Disseminating research output in the author's institutional repository increases the research impact of the author's research output as such materials are downloaded and cited more often.
- If an author's research output is disseminated to a greater extent in their institutional repository, it will help other researchers' research activities as well as each author's research.

Image Expectancy

- Disseminating research output in the author's institutional repository helps with the author's good impressions in the eyes of other researchers.
- Disseminating research output in the author's institutional repository increases the author's reputation compared to other researchers who do not offer their research output in this way.
- Disseminating research output in the author's institutional repository allows authors to be recognized as experts by their academic community.
- Disseminating research output in the author's institutional repository is beneficial to all authors' favorable publicity.

Technology Service Functionality Expectancy

- Researcher page (e-portfolio) creation and management function
- Statistics report function (e.g., usage statistics and citation analysis)
- Long-term preservation
- Open access journal publishing function
- Automatic research output depositing function linked to the institution's intra-system, such as Research Assessment Evaluation (RAE)
- Academic authoring assistance function (e.g., bibliographical tools, EndNote, RefWorks, ResearcherID)
- Linked with self-archived research outputs in a discipline subject-based repository
- Social network service (SNS) support function
- Exposure to search engines such as Google Scholar

Copyright Risk

- The publisher's (my article was published by this publisher) permission is needed when I make my research output freely accessible on the internet through my institutional repository.
- The co-author's permission is needed when I make my research output freely accessible on the internet through my institutional repository.
- Without the permission of publishers or public and private grant funders, if I make my research output freely accessible on the internet through my institutional repository, it would be a violation of copyright law.
- If I make my research output freely accessible on the internet through my institutional repository before publishing it formally, it may not be formally publishable by journals.

Plagiarism Risk

- My research output maybe plagiarized without the permission of the original author (myself).
- I am worried that my research output (e.g., research data, experimental data) would be plagiarized by others before I publish it.

Privacy Risk

- My research ideas or interests could be made available to unknown individuals or companies without my knowledge.
- Sometimes I feel that I am monitored if my research output is on the internet.
- I am concerned that my private information (e.g., name, e-mail) associated with my research output could be misused when I make them freely accessible to the public on the internet.

Facilitating Condition

- My institute has an IT resource system (e.g., internet, IT infrastructure, security system) that ensures that

members' research output is safe on the internet.
- My institute has an organization (e.g., department, staff) to assist with open access of members' research output and to solve problems related to the information dissemination.
- My institute has guidelines when members deposit and make research output freely accessible on the internet through the institutional repository.
- My institute has training sessions (programs) related to the sharing of research output.
- My institute promotes an open access policy for the dissemination of members' research output freely accessible on the internet.

Subjective Norm
- My colleagues make their academic research output freely accessible on the internet.
- My research supervisor supports open access of academic research output.
- Public and private funders ask that I make my research output freely accessible on the internet.
- My institution supports the "open access of members' (professors, researchers) research output" freely accessible on the internet.

Organizational Identification
- When someone criticizes my institution, I take it as a personal insult.
- My institution's successes are my successes.
- When someone praises my institution, it feels like a personal compliment.
- I sincerely worry about my institute's destiny.

Innovativeness
- I show an inclination to use new information systems or services before other people use them.
- I show an inclination to adopt the newest theories or experimental methods earlier than others when conducting research.
- Generally, I like to use the newest information systems or services.

Computer Self-Efficacy
- I could complete the dissemination of my research output on the institutional repository if I had never used my institution's IR before.
- I could complete the dissemination of my research output on the institutional repository if I had sufficient time to complete the job.
- I could complete the dissemination of my research output on the institutional repository if I received an explanation of its use just once.
- I could complete the dissemination of my research output on the institutional repository if I had only the manual as a reference.
- I could complete the dissemination of my research output on the institutional repository if I could call someone for help if I got stuck.

Altruism
- I like to share my research with other researchers.
- I would like to help other researchers by making my research output freely accessible on the internet.
- My research output should be made freely accessible to the public for the development of scholarly communication.

Generalized Reciprocity
- I use research output created by other researchers for my research. Therefore, I feel a personal obligation to offer my research output.
- If I obtain knowledge from the research output of other researchers, I should provide my research output to help them as well.
- If I offer my research output free of charge, I believe that I can also use the research output of other researchers free of charge.
- My research output should be disseminated for the public good (for the public interest) free of charge, as my research output was created through social support (e.g., government/university/private funding).

Adoptive Intention
- It is desirable for the affiliation to carry forth scholarly information openly, and to share it free of charge with its community members.
- I will submit and allow my scholarly information to be open by my institution's IR.
- I intend to recommend sharing scholarly information to my colleagues by using my institution's IR.