

What are Software Developers' and Medical Experts' Priorities for Adopting a Healthcare Software Platform?

Yong-Young Kim¹ and Mi-Hye Kim^{2*}

¹Division of Business Administration and Economics, Konkuk University, Republic of Korea; kyyoung@kku.ac.kr

²Department of Computer Engineering, Chungbuk National University, Republic of Korea; mhkim@cbnu.ac.kr

Abstract

Background/Objectives: Many policies are provided for promoting the software market. However, little research has studied medical experts' or software developers' requirements with regard to software platforms that focus on healthcare.

Methods/Statistical Analysis: With a literature review and interviews with experts, questionnaires were developed in order to measure five topics: Fields to be developed, expertise, problems, effect and the factors that facilitate the platform.

The survey was administered on a website for two weeks. The participants were medical experts and software developers. 97 software developers and 79 medical experts completed the survey. All of these completed surveys were analyzed using rank and priority test method.

Findings: From the results of the survey of software developers and medical experts, it is possible to see the relevant priorities of these two groups. First, software developers and medical experts believe that health condition measurement and the prevention of disease/disorder are new markets that should be opened. Second, they want to share their expertise and knowledge if they participate in a healthcare software platform. Thus, we can verify that software developers and medical experts do not differ regarding the fields that should be considered and the expertise that should be offered. Third, software developers have concerns about the absence of preparation for healthcare software certification, the absence of preparation for a healthcare database and a shortage of information about the healthcare software market. Further, after adopting a healthcare software platform, software developers expect that it will enable them to utilize a specific healthcare database, utilize expertise and develop competitive content and share domestic/foreign information on healthcare. Finally, there are priority factors that software developers believe can facilitate the platform. **Application/Improvements:** It is relevant for this study to survey two key participating supply-side groups. The results may be utilized to help provide useful directions for Korean government's healthcare software platform policies.

Keywords: Medical Experts, Network Effects, Platform, Software Developers, The Orientation Toward a Happy Korea, Two-Sided Market

1. Introduction

With the advancement of Information and Communications Technologies (ICTs) such as mobile technology¹, big data² and cloud computing³, the interest in platforms is a critical factor of corporate ecosystems. This importance is emphasized in various research domains⁴⁻⁷. Of these, the industry domain provides a platform structure through an integrative perspective⁴. With

corporate systems showing tremendous performance, some research has found that competitiveness depends upon the utilization of platforms⁵. In addition, the model of the two-sided market consists of two kinds of distinct user groups such as producers and buyers⁶. Factors for the evolution of platforms must also be considered, including platform structure, governance and platform dynamics⁷.

Alongside the academic interest in platforms, the Korean Government has begun to pay considerable

*Author for correspondence

attention to the adoption of platforms, especially software platforms. In this regard, the Park Geun-Hye Administration's vision of a "Happy Korea, a New Era of Hope" comprises two goals: Solving social problems and improving the quality of life⁸.

In order to support ICTs, Park's Administration has made an effort to develop ICT platforms. For example, a government committee, the Information Technology Strategy Committee, was constituted recently. This plays a pivotal role in integrating and coordinating national ICT policies. The committee has officially determined "A master plan for ICT promotion and convergence facilitation" that includes 16 programs divided into four topics. Park's Administration has resolved to promote the topics as a priority for three years from 2014 to 2016. The purpose of this plan is twofold: To concentrate on preparing for a revolutionary era when persons, things, devices, etc. are "hyper-connected" over the internet and to construct a platform to increase the competitiveness of industries such as those that produce software, parts and equipment. The government's ICT policy to promote and converge software and related industries focuses on the selection of four topics (safety, health, convenience and culture) as a "new convergence industry for a Happy Korea". In this way, the Korean government is endeavoring to improve the quality of life and create high-quality jobs. Among the four topics, health is the most attractive because of the size of the global healthcare market. This is now US \$9.59 trillion according to a report, *Global Health's New Entrants: Meeting the World's Consumer*, issued by Pricewaterhouse Coopers (PwC) in 2015. A healthcare platform plays a critical role as one of the Happy Korea-oriented technologies because it has an impact on software developers and customers. Further, the technology can prove to be convenient for third parties such as medical experts.

Healthcare software platforms appear to be easy to build because of the advance of ICTs. However, without medical experts they face a high barrier to healthcare market entry with regard to users and patients. This is illustrated by the failure of Google Health. As a healthcare platform of Personal Health Records (PHR), Google Health started in 2008. It intended to empower consumers by allowing them to share medical records, track their health progress and refine their health and wellness searches. Nonetheless, Google closed its health service on January 2, 2012. There are many reasons why Google Health failed; for example, it was not fun or social, did not inspire trust and did not involve doctors^{9,10}. Thus, as

the case of Google Health illustrates, a healthcare platform must attract the participation of medical experts and build trust between software providers and users. Consequently, in order to distribute healthcare software successfully on a platform, not only software developers but also medical experts play critical roles.

Many policies are provided for promoting the software market. However, little research has studied medical experts' or software developers' requirements with regard to software platforms that focus on healthcare. Thus, we explore such requirements. By so doing, we provide an opportunity to discover priority policies that the government should actively support with regard to a healthcare software platform.

The rest of this paper is organized as follows. The next section briefly reviews related work, including the concept of platform and platform-mediated networks. After this, the study's survey instruments are developed in order to test the priority ranking of healthcare software platform adoption. The administration of the research surveys is then described, followed by statistical analysis. The study concludes with a discussion of its contributions and limitations. Suggestions are also made for future research.

2. Related Work

2.1 The Concept of Platform

According to the Oxford Dictionary Online, the term "platform" refers to "a design, a concept, an idea; (something serving as) a pattern or model". The origin of the word "platform" is from the French *plateforme*, which means "ground plane" or literally "flat shape". In a contemporary sense, a platform refers to a raised level surface on which people or things can stand. Further, in the ICT domain, it means a standard for the hardware of a computer system that determines the kind of software that the computer can run.

In the research field, the notion of a platform is used in marketing (product lines), software engineering (software families), economics (products and services that bring together groups of users in two-sided networks)¹¹, information systems (infrastructural investments)¹² and industrial organizations (forming systems)¹³.

Prior research defines the term "platform" in various fields including systems, business, product development and industrial economics. System researchers define it as "the extensible codebase of a software-based system that

provides core functionality shared by the modules that interoperate with it and the interfaces through which they interoperate”⁷. From the business platform perspective, “platform” refers to “the system where suppliers and consumers make a relationship and transact for business with each other” or “the base where many participants make economic value according to shared standard or rules”⁵.

Product development researchers have used the term “platform” to explain “projects that created a new generation or family of products for a particular firm”⁴. According to Meyer and Lehnerd¹⁴, a product platform refers to “a set of common components, modules or parts from which a stream of derivative products can be efficiently created and launched”. Industrial economists have cited Rochet and Tirole’s¹⁵ platform definition: “To characterize products, services, firms or institutions that mediate transactions between two or more groups of agents”. At the industry level, “platform” means “a bundle of standard components around which buyers and sellers coordinate efforts”¹⁶.

An argument exists among researchers about whether a platform is an asset or a set of shared components. According to Iansiti and Levien¹⁷, a platform is “an asset in the form of services, tools or technologies that offers solutions to others in the ecosystem”. In contrast, assuming that a platform is a shared component, researchers⁴ define “platform” as “a set of stable components that supports variety and evolvability in a system by constraining the linkages among the other components”. Indeed, it seems better that the term “platform” refers to shared components rather than an asset because it forms a shared relationship of symbiosis and coevolution¹⁸.

Most platform concepts have concentrated on the “reuse” or “sharing” of common elements across complex products or systems of production⁴. Component reuse and sharing is very important because it is the foundation of economies of scale⁴. With regard to components that are fixed, it is often possible to realize economies of scale through increased production volume. At the same time, economies of scope are created at the system level by reducing the cost of developing product variants that are targeted at different markets or incorporate new technologies.

2.2 Platform-Mediated Networks

A platform is a core factor of an industry ecosystem as well as a mediator and pivot that connects different user

groups. A platform is also a foundation that complements and mediates each value of the participants with the shared components of the value complex. The healthcare software platform considered in this study is expected to be a type of platform-mediated network.

The criterion of platform-mediated networks is the number of participating user groups. Markets with homogenous users are called one-sided in order to distinguish them from two-sided markets. The latter have two distinct user groups, such as software developers and users, whose respective members consistently play a single role in transactions¹⁵.

In traditional industries, two-way exchanges follow a linear path. For example, a manufacturer buys materials (input), transforms them and sells products (output)¹¹. However, platform-mediated networks form a triangular scheme (see Figure 1). Users transact with each other and simultaneously connect with platform providers.

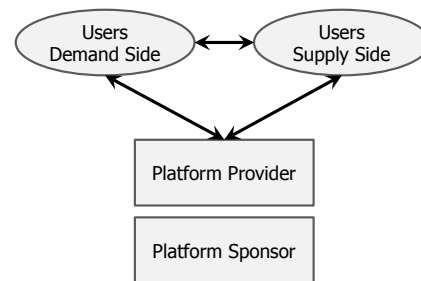


Figure 1. Elements of a two-sided platform⁶.

There are four types of participant in platform-mediated networks (see Figure 1)⁶. First, demand-side platform users are “end-users.” Second, supply-side platform users are connected to platform providers and simultaneously provide complementary goods for demand-side platform users. Third, a platform provider mediates the transaction between demand-side and supply-side users and supplies a service that enables the platform and the users to be connected. Platform providers serve as the primary point of contact with the platform that the demand-side and supply-side users both use. Finally, a platform sponsor does not transact directly with demand-side and supply-side users but has the right to revise the platform technology. The platform sponsor operates the intellectual properties, establishes a participating criterion for the platform and is responsible for platform technology development. A platform sponsor plays a platform designer’s role such as setting functions, building the structure, making rules and determining the scope of users⁵.

From the perspective of a platform-mediated network, there are two-sided and multi-sided markets. A two-sided market expands into a multi-sided market when there are more than two distinct user groups. The health/rehabilitation software platform that we provide in this paper as a Happy Korea-oriented platform model is a multi-sided market with at least three participants such as medical experts, IT developers and patients.

A healthcare software platform has a two-sided market because there are many software developers and many software users. In order for the two-sided market to be established, there are two requirements: 1. Network effects and 2. Internalizing these externalities through a platform. A two-sided market consists of users whose transactions are subject to direct and/or indirect network effects together with one or more intermediaries that facilitate users' transactions^{11,15,19}. Direct network effects mean that consumers may value a product more if similar consumers use that product as well. Indirect network effects mean that one type of economic agent may value a product more if another group of economic agents also uses that product²⁰. Further, indirect network effects mean that the customer group of one market has greater utility when the customer group of another market expands. Thus, the users of a software platform obtain more benefits when the number of software developers expands, while software developers obtain more benefits when the number of users grows.

According to Evans²⁰, indirect network effects can arise because one type of economic agent (e.g. a computer user or a videogame user) wants to find complementary products for the platform that he or she uses (e.g. applications or videogames). The makers of these products want to focus their efforts on platforms that have users who demand their products. However, it is difficult for different customer groups to transact directly with each other because of high transaction costs. A platform can make the internalization of these externalities possible. Further, it is difficult for healthcare software developers to transact directly with many users because public benefit takes precedence over everything. Thus, a software platform that the Korean government promotes and supports makes it possible to internalize the relevant externalities.

A healthcare software platform is certainly linked to national health. Medical experts as well as software engineers are important when building such a platform. It is also necessary to consider who will be the healthcare software platform sponsors in order to design the com-

ponents and rules. In addition, it is important to consider who will be the healthcare platform provider so that users can be given a primary point of contact with the platform.

In order to achieve the network effect of healthcare software, many users must engage with it. In this way, the platform creates a virtuous cycle: The more users who engage with it, the more valuable the network becomes, thus attracting more users. Since users trigger the network effect, it is important to encourage them to participate in the platform.

3. Research Method and Results

3.1 Research Framework

This study aims to identify the priorities for adopting a healthcare software platform in order to attract two key participants: Software developers and medical experts. Further, the success of adopting a healthcare software platform depends upon a virtuous network cycle: The more users who engage with it, the more valuable the network becomes. In this context, following the theory of a platform-mediated network, the research framework is built (Figure 2).

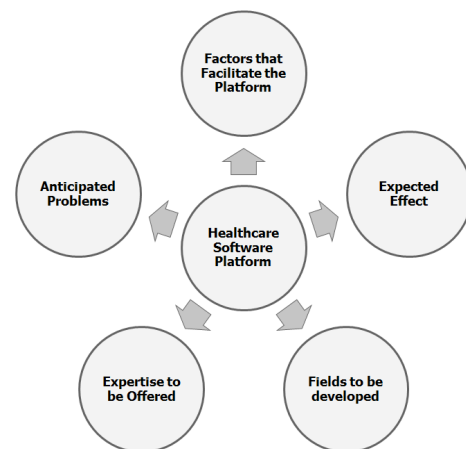


Figure 2. Research framework.

An increasing number of users is critical in order to generate the network effects of a healthcare software platform. In order to ensure the success of such a platform, strategies are needed to enlarge the number of users. Demand-side users want to obtain medical services or treatment based on software. However, supply-side users such as doctors, pharmacists and nurses do not necessarily provide healthcare services over a software platform.

Thus, it is important to select a basic zigzag strategy in order to draw preferred supply-side users. Such a strategy builds participation on both sides incrementally²⁰. The platform starts with a small number of economic agents on these two sides and then persuades more agents on either side to join.

After reviewing the literature, interviewing professionals, and holding discussions with two authors, we selected five issues in order to attract supply-side users: 1. The fields to be developed for a healthcare software platform, 2. The expertise to be offered if software developers and medical experts participate in the platform, 3. The anticipated problems in building the platform, 4. The expected effect of adopting the platform and 5. The factors that facilitate the healthcare software platform.

3.2 Research Methodology

This study conducted a survey about the adoption of a healthcare software platform. The research subjects were software developers together with medical experts such as doctors, pharmacists and nurses. Questionnaires were developed in order to measure five topics. Some of the survey items were chosen from prior research and the others were developed based on interviews with professionals. All the items were measured with a Likert five-point scale. Thus, the survey items were developed with a literature review and interviews with experts.

Pilot tests were conducted with professionals and practitioners. After the pilot tests and following two discussions with authors and interviews with experts, several survey items were revised. The final questionnaires were then developed for two key participating groups with regard to a healthcare software platform: Software developers and medical experts. The survey items were categorized into five topics: 1. The fields to be developed for a healthcare software platform (nine items), 2. The expertise to be offered if software developers and medical experts participate in a platform (nine items), 3. The anticipated problems in building a platform (18 items), 4. The expected effect of adopting a platform (13 items) and 5. The factors that facilitate a healthcare software platform (15 items). Topics 3–5 were directed at software developers only.

We used an online survey method in order to investigate nationwide respondents. The survey was administered on a website for two weeks. The participants were medical experts and software developers. 97 software developers

and 79 medical experts, including doctors, pharmacists and nurses, completed the survey. All of these completed surveys were analyzed.

Table 1 shows the demographics of each responding group. With regard to software developers, there were 76 (78.4%) male respondents and 21 (21.6%) female. Many respondents were in their thirties (39.6%) and 34 respondents were in their forties. Thus, most of the respondents were aged between 29 and 50. With regard to the number of years that they had tenure in their jobs, 67.0% of respondents had more than five years. The medical experts consisted of 29 (36.7%) male respondents and 50 (63.3%) female respondents. In terms of the distribution of their ages, 57 (72.1%) respondents ranged in age from 25 to 39 and 22 (27.9%) were 40 or over. 65.8% of respondents had tenure of more than five years. Thus, the medical experts and the software developers were experienced enough to respond to our questions about adopting a healthcare software platform.

Table 1. Demographics

Description		Software Developers (n=97)	Medical Experts (n=79)
		Samples (%)	Samples (%)
Gender	Male	76 (78.4%)	29 (36.7%)
	Female	21 (21.6%)	50 (63.3%)
Age	19–24	3 (3.1%)	-
	25–29	19 (19.8%)	17 (21.5%)
	30–34	21 (21.9%)	25 (31.6%)
	35–39	17 (17.7%)	15 (19.0%)
	40–44	26 (27.1%)	5 (6.3%)
	45–49	8 (8.3%)	10 (12.7%)
	50–54	2 (2.1%)	7 (8.9%)
	>54	1(1.0%)	-
Tenure (years)	< 1	9 (9.3%)	4 (5.1%)
	1–3	21 (21.6%)	13 (16.5%)
	3–5	2 (2.1%)	10 (12.7%)
	5–10	30 (30.9%)	19 (24.1%)
	10–15	20 (20.6%)	9 (11.4%)
	15–20	10 (10.3%)	8 (10.1%)
	≥20	5 (5.2%)	14 (17.7%)

3.3 Survey Results

The software developers selected the following three fields as the most important in terms of healthcare prioritization: 1. A health condition measurement for a family's

health condition, 2. The prevention of lifestyle diseases such as hypertension, diabetes and hyperlipidemia and 3. The prevention of mental health problems such as depression, insomnia and stress. Medical experts also selected similar fields, although they gave a ranking of six to the health condition measurement for a family's health condition. Full details are in Table 2.

Table 2. Healthcare fields of a software platform

Items	Software Developers' Ranking	Medical Experts' Ranking
Health condition measurement for a family's health condition	1	6
Prevention of lifestyle diseases (e.g., hypertension, diabetes, hyperlipidemia)	2	1
Prevention of mental diseases (e.g., depression, insomnia, stress)	3	2
Prevention of cognitive disorders (forgetfulness, dementia)	4	3
Providing information about medical institutions (e.g., medical qualities and costs)	5	9
Providing information about online communities (regarding relevant diseases and treatments)	6	8
Rehabilitation of physical functions	7	4
Providing information about toxic substances in the living environment	8	5
Providing information about the latest disease and medical service	9	7

If software developers and medical experts participate in a healthcare software platform, they want to offer an expert service in accordance with the following top three priorities: 1. Answering users' questions, 2. Sharing his/her own expertise and 3. Exchanging knowledge. Table 3 contains the full details.

With regard to the anticipated problems of developing a platform, software developers selected the following as their top three concerns: 1. No preparation for the certification of healthcare software, 2. No preparation for a healthcare database and 3. An information shortage about the healthcare software market. Table 4 has the full details.

Table 3. Expertise that professionals participating in a software platform can offer

Items	Software Developers' Ranking	Medical Experts' Ranking
Answering users' questions	1	1
Sharing his/her own expertise	2	2
Exchanging knowledge	3	3
Providing his/her own information/advice to developers	4	5
Creating new professional jobs	5	7
Enhancing information reliability	6	4
Placing his/her specialized information on the human database for users	7	9
Placing his/her specialized information on the human database for developers	8	8
Reward for offering his/her own expertise	9	6

Table 4. Anticipated software platform problems

Items	Software Developers' Ranking
No preparation for the certification of healthcare software	1
No preparation for a healthcare database	2
Information shortage about the healthcare software market	3
Lack of planning ability	4
Lack of experience in developing software	5
Lack of users' understanding	6
No improvement regarding the law/institutions of healthcare software	7
Lack of healthcare professionals' advice	8
Shortage of information about offering healthcare at home and abroad	9
No preparation for a healthcare review system	10
No preparation for the relationship among healthcare software developing companies	11
Shortage of software development funds	12
Lack of effective marketing and advertising	13

Lack of a venture center	14
Problems about a software distribution structure	15
Market entry barriers	16
Insufficient competition regarding content	17
Lack of well-trained professional software developers	18

With regard to the anticipated effect of adopting the platform, software developers chose the following issues as their top three priorities: 1. Utilization of a specific database on healthcare, 2. Support in utilizing expertise and developing competitive content and 3. Sharing domestic/foreign information on healthcare. Table 5 has the full details.

Table 5. Expectations regarding a software platform

Items	Software Developers' Ranking
Utilization of a specific database on healthcare	1
Support in utilizing expertise and developing competitive contents	2
Sharing domestic/foreign information on healthcare	3
Building a software distribution system and facilitating domestic/foreign market entry	4
Support for utilizing a human database and providing expert advice	5
Enhancing the reliability of health/rehabilitation software with government certification	6
Understanding user requirements	7
Enhancing software planning ability with a human database	8
Support for early-stage software firms entering the new market	9
Support for effective marketing and advertising	10
Support for forecasting the market demand for health/rehabilitation software	11
Utilization of expertise and support for one-person businesses/small businesses	12
Searching for and securing a software development workforce	13

In order to facilitate a healthcare software platform, software developers suggest that the following are the three most important considerations: 1. Having ties with

medical institutions and achieving content reliability, 2. Obtaining health/rehabilitation software certification and having the confidence of the public and 3. Providing public services for national health promotions. See Table 6 for the full details.

Table 6. Facilitating factors of a software platform

Items	Software Developers' Ranking
Having ties with medical institutions and achieving content reliability	1
Obtaining health/rehabilitation software certification and having the confidence of the public	2
Providing public services for national health promotions	3
Participating and collaborating with health/rehabilitation professionals	4
Building a specific database for health/rehabilitation software development	5
Gathering and reusing the data of health/rehabilitation software users	6
Discovering and funding excellent health/rehabilitation content	7
Professional software developers participating and sharing information	8
Providing health/rehabilitation expert consultations	9
Reforming health/rehabilitation software-related laws and systems	10
Providing effective marketing and advertising	11
Training professional software developers	12
Building a health/rehabilitation software distribution system	13
Support for the market entry of venture businesses into health/rehabilitation	14
Support for entering the domestic/global market	15

4. Conclusions

Through reviewing the literature, interviewing professionals and holding discussions with two authors, we obtained five issues about the adoption of a healthcare software platform. In order to adopt such a platform, this study suggests that the following five topics should be considered: 1. A search should be conducted for relevant healthcare fields, 2. Software developers' and medical experts' exper-

tise should be offered, 3. Anticipated problems should be solved, 4. Expectations should be maximized and 5. Facilitating factors that promote a healthcare software platform should be identified. Further, from the results of the survey of software developers and medical experts, it is possible to see the relevant priorities of these two groups.

First, software developers and medical experts believe that health condition measurement and the prevention of disease/disorder are new markets that should be opened. Second, they want to share their expertise and knowledge if they participate in a healthcare software platform. Thus, we can verify that software developers and medical experts do not differ regarding the fields that should be considered and the expertise that should be offered.

Third, software developers have concerns about the absence of preparation for healthcare software certification, the absence of preparation for a healthcare database and a shortage of information about the healthcare software market. Further, after adopting a healthcare software platform, software developers expect that it will enable them to utilize a specific healthcare database, utilize expertise and develop competitive content and share domestic/foreign information on healthcare. Finally, there are priority factors that software developers believe can facilitate a healthcare software platform. These are as follows: Having ties with medical institutions and gaining content reliability, obtaining healthcare software certification and having the confidence of the public and providing public services for national health promotions. As shown on Figure 3, we can summarize the results of this study.

This study has several implications. First, the survey considers only the supply-side users of a healthcare software platform. Prior research has focused on demand-side

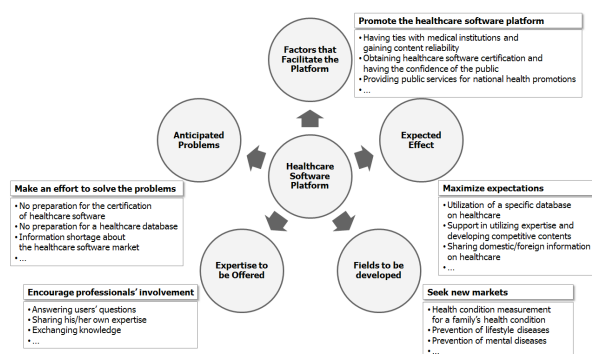


Figure 3. Software developers' and medical experts' priorities.

users; namely, end-users. Nonetheless, it is relevant for this study to survey two key participating supply-side groups, software developers and medical experts. As shown by the failure of Google Health, medical experts' intention to participate in a healthcare software platform influences the success of the platform. Second, this study is limited because of its use of exploratory research. Future research should consider all the possible topics related to the adoption of a healthcare software platform. Third, this study's findings only show rankings with regard to five topics relevant to the adoption of a healthcare software platform. Future research should explore the process or the causal effects among the factors in each topic.

The findings display the necessary precedence of priorities that are required for a healthcare software platform. The results may be utilized to help provide useful directions for the Korean government's execution of healthcare software platform policies. A healthcare software platform is an innovative infrastructure that improves the quality of life. In this regard, the precedence factors of a healthcare software platform should be investigated in their early stages so that the Korean government can assess the preparation that is required for such a platform.

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