Developing Measures for Empirical Research on Economic Activities of the Convergence Generation: Exploratory Approach

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ABSTRACT

Ultimately, this research will focus on the activity traits of future customers in the convergence age. To accomplish that, firstly, researcher develop measures for assessing the convergence level of digital devices and digital services. Next, this will investigate the behavioral traits of people who use specific devices or services on the internet or mobile networks. This study proposed five convergence measures each for devices and services. For digital devices, measures such as converged functions, accessibility to network, portability, immediate communicability, and expandibility of functions were utilized. For digital services, measures such as scope of users, newness, social network level, ease-of-use on mobile networks, and expandibility of information were used. We believe that the research results can provide insights for those wishing to explore the convergence level of devices and services and those developing high-level converged devices and digital services.

Key words: Digital Convergence, Digital Service, Digital Device, Convergence Level, Social Network Service, Smart Phone

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1. Introduction

The term "digital convergence" may have the meaning of compounding and merging among diverse devices and services using digital technologies. Recently, however, the concept has been modified to reflect the trend of providing an environment of human-centered communication with a dissolving boundary between broadcasting and communication.

Especially, the trend toward converging and mixing in digital technologies may be originated from compound development among technologies, enterprises, policies and consumers. First, in digital technologies and systems, it may have been come from the emergence of highly integrated chips, expansion of wire- and wireless broadband networks, and advancements in hardware and software.

Second, in the case of firms, according to environmental changes such as shortened lives of products and services, outside and internal market pressures, diverse needs of consumers, and intensification of competition by free trading, many firms have to make an effort to gain competitive advantages.

Third, consumers in the digital convergence age have gradually demanded high-end and multi-functional products, mobile computing, personalized products and services, information-intensive amenities, and entertainment-oriented services. The so-called "netizens" who have grown up using the internet have become the core generation for economic activities in the digital convergence age.

Fourth, major motivations behind governmental policies may include globally opened markets, enlargement of policy support for new technologies, and entering into domestic markets of global companies as promotional elements for activation of digital convergence age[3].

As previously mentioned, this research consists of two phases: to develop a tool for assessing levels of convergence of digital devices and services, and in the second phase, to investigate characteristic economic behaviors of the convergence generation. Therefore, in this exploratory research, we focus on the first phase results.

2. Theoretical Background

The technological foundation that can make digital devices and services blended and converged to new media comes from the epoch-making development of digital technologies. Digital technologies blended and mixed into one or more devices may usher in life-altering changes in terms of thinking patterns, lifestyles, types of economic behaviors, human relationships, industrial structures and value judgements. Moreover, business paradigms whereby firms have produced and provided their own offerings and social mechanisms have been also changed by digital convergence.

In diverse areas, tools for assessing convergence levels of specific fields have been studied until now. However, it is difficult to find research results for quantified assessment of convergence technologies. Conceptually, the convergence technologies can be defined as one phenomenon where individual technologies with no relations are converged into a system or a device operating multiple functions.

In order to evaluate the level of cutting-edge technologies in public fields, Lee suggested three criteria, namely technical level, marketability, and publicness[5]. In the aerospace sector, criteria such as level of future cutting-edge technologies, publicness, and intrinsic functionality of specific public agents have been suggested for evaluating the level of core technologies[6]. For prioritizing prospective technologies in research organizations

supported by government, Kim and Lee proposed four measuring criteria such as level of technical groundwork, coincidence between technologies and strategies, possibility of market growth in future, and availability of budget from government[2].

In the area of quality of service, determinant elements for measuring level of service quality can be excellence in overall service or superiority[10]. Generally, to evaluate level of service quality, SERVQUAL[8], SERVPERF[7], EP Model[9], etc. have been used. For measuring broadcasting service level, information conveyance, aesthetic design, system interface, reliability of contents, communication capability, and stability of system have been suggested[4].

3. Development of Measures for Digital Convergence

3.1 Processes

Our processes for evaluating the convergence level of digital media are as followings. Figure 1 depicts the procedure.

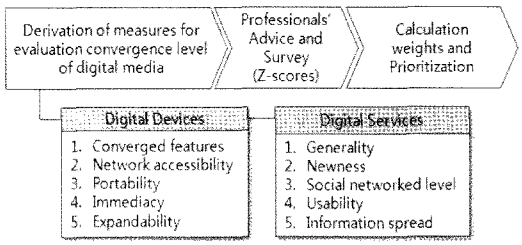
First, as for criteria for evaluation of convergence level, the research derived five measures for digital devices and services on the basis of advice from professionals.

Second, to check out feasibility and reliability of measures and prepare a basis for calculation of convergence level, group interviews and questionnaire surveys for professionals were conducted.

Third, on the basis of professional opinions, weights (Z-score) of digital media were evaluated and the results yielded ranked convergence levels for digital devices and services.

3.2 Measures for convergence level

On the basis of discussion and consultation with interested parties in digital media, the research



[Figure 1] Processes of research

constructed five measures for devices and services respectively.

Concerning the digital devices, first, "converged features" can be defined as diversity of functions in one medium. For instance, in terms of diversity of features, smart phones may have more functions than a cellular phone. And compared with a digital camera, netbook or desktop PCs have more features in general[1].

Second, the "network accessibility" measure is used to evaluate whether the device itself can connect to a wire- or wireless network and internet, anywhere and anytime. This measure is to assess level of ease in connecting to a wired network such as LAN or MAN, or wireless network such as Wi-Fi or Bluetooth.

Third, "portability" means that when users leave the home/office, the device is easy to carry, for example, fitting into a coat pocket or small bag given its size, weight, and volume.

Fourth, "immediacy" refers to having the capability to send or receive large amounts of data like images or video clips when circumstances such as an accident require immediate access. Moreover, the measure includes whether it is possible for users to locate specific information or to transact banking business or purchase something via the internet while "on-the-go."

Fifth, "expandibility" is used to assess possibility of setting up diverse applications, not proprietary and fixed features in a specific device. This means that several applications can be downloaded and

<Table 1> Category of Devices and Services

Items	Devices and Services	Abbr.
Digital devices	Desktop PC	DPC
	Notebook PC	NPC
	Netbook	NBK
	PMP	PMP
	PDA (Electronic wallet or Organizer)	PDA
	Digital Camera	DCA
	Cellular phone	HPN
	Smart phone (iPhone, Galaxy, Optimus, etc.)	SPN
	Portable game device (Nintendo, etc.)	MGM
	MP3	MP3
	Tablet PC (iPad, Galaxy tab. etc.)	TPC
Digital services	Internet shopping mall/Auction	SA
	Internet broadcasting	BC
	Cyworld/Facebook/Myspace, etc.	FB
	Twitter (internet, smart/cellular phone, etc.)	TW
	Internet cafe	CF
	UCC (Pandora TV, U-tube, etc.)	UC
	Internet portal (Naver, google, etc.)	PT
	Messenger (Nate-on, Messenger, Buddy, etc.)	MS
	Internet blogs	BL
	Application store for smart phone	AS
	SMS	SM
	Internet email service	EM
	Wire or wireless network game	GM
	BBS (internet discussion service)	BB
	File download (MP3, movie, etc.)	FD
	e-Book services	EB
	Web Hard-disk	WH
	Internet theater or music, etc.	IM

set up on the devices.

This research included eleven digital devices such as desktop PC, notebook PC, netbook, PMP, smart phone, tablet PC, and so on to evaluate level of convergence of digital devices. For digital services, five criteria were used: generality, newness, social networked level, usability, and information spread. First, the "generality" of use indicates how many users usually use a specific digital service in daily life with no relation to age, profession, gender, educational background, and so on.

Second, "newness" means that a digital service previously did not exist (or was not actively used), but increased in popularity lately.

Third, the "social networked level" is a criterion to assess level of social networking among participants on the service.

Fourth, the "usability" of a service refers to its ease-of-use, anywhere, anytime while a user is walking on the street or in any office without inconvenience.

Fifth, the "spread of information" is for evaluating speed and scope or coverage of information spread among members.

For this research, eighteen services such as Twitter, Facebook, internet portal, and so forth have been included to assess level of convergence.

3.3 Evaluation methodology

On the basis of input from opinion leaders and interested persons, ten measures were proposed to another group of professionals (14 persons). To evaluate level of convergence of digital media, they willingly participated in a questionnaire survey and face-to-face interview. Ten measures for digital devices and services were evaluated using a Likert scale (1-Very Low, 2-Low, 3-Medium, 4-High, 5-Very High).

<Table 2> Respondents

classification		freq.
profession	professor	4
	R&D researcher	5
	business man	1
	student	4
degree	Ph.D.	6
	Dr. course	4
	Master course	4

4. Research Results

4.1 Convergence level of digital devices

As shown in [figure 2], full marks evaluated from respondents should be 70(Likert 5 score x 14 persons=70). In figure[2, 3], numbers marked on histograms mean the evaluated scores(level of convergence) of each devices and services.

With regard to the measure of "converged features," the device with the highest level of convergence was the smart phone, followed by the tablet PC (Galaxy Tab, iPad, etc.) and notebook PC. In the case of smart phones, as the concept of the product may be derived from taking a mobile phone and adding PC features, users might perceive that smart phones have the highest level of converged features. The tablet PC also might be favorably viewed given that it has highly merged and mixed functions of PCs with communication. Relatively, a notebook without features of mobile phone has slight lower level than smart phone or tablet PC.

As for the criterion of "network accessibility" (i.e. ease of connection to wired or wireless networks), smart phones were again rated highest, followed by netbooks and notebooks, respectively.

Meanwhile, as for "portability," leading devices were smart phone, mobile phone, and MP3, respectively.

In terms of "immediacy" (i.e. ability to transmit a large amount of data and conduct transactions anywhere, anytime), the top-ranked devices were smart phone, mobile phone, and netbook. And finally, our measure of function "expandability" (i.e. not only proprietary and fixed features but possibility of adding diverse applications to a specific device), the smart phone presented the highest convergence level, followed by the desktop and notebook PC.

The smart phone, consequently, was the device with the highest convergence level.

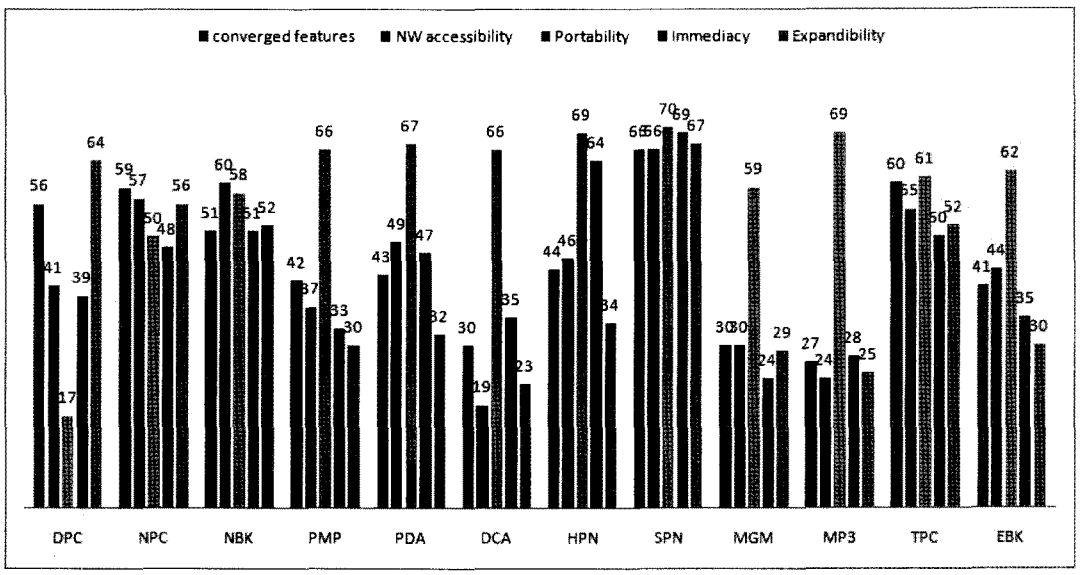
4.2 convergence level of digital services

Next, in order to evaluate the convergence level of digital services such as Twitter, internet shopping malls, application stores, and so on, an evaluation was carried out by professionals.

Overall, the results for the five measures indicate that the services with the highest convergence levels were internet portals such as naver.com and google.com. These were followed by mobile phone SMS, internet shopping malls, and internet auction services, sequentially.

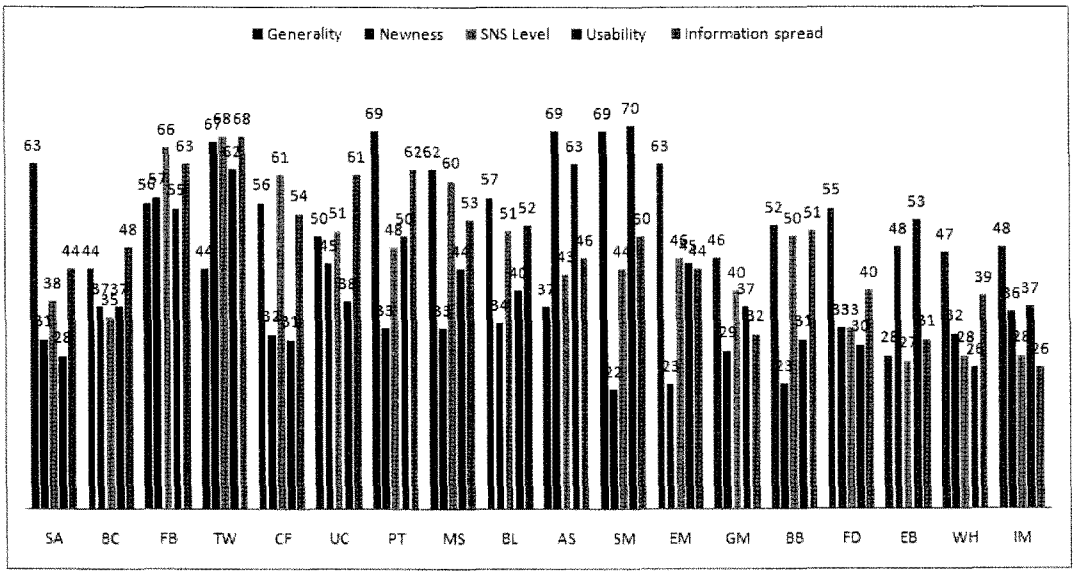
<Table 3> Criteria of Convergence Level(Proposed)

items	Criteria	Remarks
Digital Devices	Converged features	Diversity of converged features
	Network Accessibility	Possibility of connection to wire- or wireless networks in anytime, anyplace(wireless, Wi-Fi networks etc.)
	Portability	Easy-to-carry, proper weight and size
	Immediacy	Speed and properness of information searching on street, reportability of accidents or events to internet or cyber spaces, easy-to-transact, etc.
	Expandibility	Possibility of setting up diverse applications, not proprietary and fixed features in specific devices
Digital Services	Generality	Wideness and depth of service users
	Newness	Recently popular services, but not existing or unknown before
	Social Networked Level	Easiness of network establishing among global users
	Usability	Usability without any inconvenience in anyplace and anytime
	Information spread	Wideness and rapidity of scope in information spread



[Figure 2] Convergence level of digital devices

The service that presented the highest level of convergence in terms of "usability" was the application store or android market for smart phones. This was followed by social network services such as Twitter, Facebook, and so on. Services ranked highly in terms of "information spread" were social network services such as Twitter, Facebook and Myspace, followed by internet portals and UCC service.



[Figure 3] Convergence level of digital services

4.3 Weight calculation(Z-scoring)

To apply the convergence level to each of the digital media, a Z-score using weights was calculated. In the second phase of research, the Z-score will be used for evaluating individual level of convergence of users. For instance, if the first respondents marked as shown in <table 4>, weight of smart phone will be calculated as follows. For this, the formula is

$s_i = a + b + c + d + e = 23$.

Let $S_k = \sum s_i (i = 1, \ldots, 14)$ be the sum score of professionals. In order to calculate weights ($Z_k = (S_k - \bar{x})/s$) of each device, we need mean and standard deviation. Therefore, let $T = \sum S_k (k = 1, \ldots, 12)$ be the sum of scores of 12 devices. Here, mean($\bar{x} = T/12$) and standard deviation($s = \sqrt{\sum (S_k - \bar{x})^2/(n-1)}$) can be calculated. Hence, calculated Z_k will be weights of each of devices and services. <Table 6> shows final result of weights.

<Table 4> Calculation of converged level of smart phone (example of first respondent)

Devices	Converged features (a)	Network accessibility (b)	Portability (c)	Immediacy (d)	Expandibility (e)	Sum (s_i)
Smart phone	5	4	5	5	5	24

<Table 5> Calculation of converged level of twitter service (example of first respondent)

Services	Generality (a)	Newness (b)	Social Networked Level (c)	Usability (d)	Information Spread (e)	Sum (s_i)
Twitter	3	5	5	5	5	23

<Table 6> Results of opinions of professionals

Respondents Num.		1	2	3	4	5	6	7	8	9	10	11	12	13	14	sum	weight(Z)	pri
Profession*		S	R	R	S	B	R	P	R	S	S	P	P	R	P			
Degree**		S-	D-	D-	S-	D-	D	D	D	S-	S-	D	D	D-	D			
Digital devices	Smart phone	24	24	25	25	25	23	23	25	24	24	24	25	25	25	341	2.061	1
	Tablet PC	22	23	13	24	18	15	20	20	23	22	14	25	19	20	278	0.843	2
	Netbook	14	20	24	22	19	20	17	21	19	24	19	16	15	22	272	0.727	3
	Notebook PC	15	20	20	22	17	20	19	21	20	23	19	17	16	21	270	0.688	4
	Cellular phone	13	16	21	18	18	15	18	19	20	23	19	22	20	16	258	0.456	5
	PDA	18	18	18	14	17	12	20	17	12	22	20	18	18	14	238	0.069	6
	Desktop PC	12	13	16	20	11	21	14	16	16	17	20	13	16	14	219	-0.298	7
	eBook device	14	13	13	17	17	10	17	14	16	17	13	18	19	13	211	-0.453	8
	PMP	10	18	18	14	12	12	20	14	10	19	11	18	20	12	208	-0.511	9
	Digital camera	12	11	14	11	11	9	14	12	10	14	10	16	20	9	173	-1.187	10
	MP3	10	11	12	13	12	10	16	9	9	17	10	14	20	10	173	-1.187	10
	Portable game device	9	14	12	13	11	8	14	10	15	12	11	14	18	11	172	-1.207	12
Digital services	Twitter	23	22	24	24	19	23	23	20	25	20	23	24	18	21	309	2.064	1
	Facebook, etc.	23	21	23	24	20	15	21	20	25	14	23	24	20	20	293	1.664	2
	Internet portal	19	18	22	19	21	22	18	17	15	15	18	20	22	16	262	0.887	3
	App. store	17	18	23	19	19	17	20	18	18	23	12	20	13	19	256	0.737	4
	SMS	13	18	20	16	20	17	21	17	17	16	21	19	21	19	255	0.712	5
	Messenger	17	17	24	19	19	18	20	15	18	16	18	19	17	17	254	0.687	6
	UCC site	18	13	19	21	20	21	19	17	17	14	20	19	14	13	245	0.462	7
	Blog	13	18	23	17	18	13	17	19	16	16	19	20	11	14	234	0.186	8
	Internet cafe	12	16	15	13	18	18	18	18	15	14	21	19	17	13	227	0.011	9
	email	10	16	20	17	14	17	17	16	13	13	19	17	18	14	221	-0.139	10
	BBS	12	14	16	14	18	15	18	16	11	12	19	17	12	15	209	-0.440	11
	Mall/auction	16	13	15	16	12	16	18	13	15	13	15	17	14	11	204	-0.565	12
	iBroadcasting	12	15	20	15	9	15	20	18	14	8	17	15	13	9	200	-0.665	13
	File Down	11	11	19	11	14	13	20	18	8	12	14	15	12	13	191	-0.890	14
	e-Book	14	9	14	15	15	15	15	14	14	14	15	13	8	12	187	-0.990	15
	Network game	10	13	15	12	10	14	15	13	10	12	17	16	10	17	184	-1.065	16
	Internet movie	12	13	18	13	10	15	15	18	9	9	13	11	8	11	175	-1.291	17
	Web hard	15	9	17	11	15	11	13	13	8	8	12	12	16	12	172	-1.366	18

*S: student, R: researcher, P: professor, B: business man, **S-: master, D-:doctoral course, D: Ph. D

4.4 Application of Convergence Level

By using weights derived from previous section, level of convergence of each user can be calculated. For example, if a user checked devices such as smart phone(Z=2.061), netbook(Z=0.843), and cellular phone(Z=0.727), convergence level of this user will be 3.631 as the sum of weights of three devices.

Ultimately, this research aims to investigate

whether important differences exist among users with regard to economic behavior and media use in relation to convergence levels of devices and services. To investigate differences in economic behaviors, traits of future economic behaviors and activities in the digital environment were suggested as dependent variables.

5. Conclusion

This exploratory research proposed criteria to measure convergence levels of digital devices and services. The proposed measures of convergence level of digital devices were five criteria such as converged features, network accessibility, portability, immediacy, and expandability. For digital services, five criteria such as generality of use, newness, level of social network, usability, and information spread were suggested.

On the basis of above criteria, according to professionals' opinion, results showed that the smart phone had the highest level of convergence, followed by the tablet PC and netbook. And concerning the convergence level of digital services, social network services such as Twitter, Metoday, and Facebook showed higher convergence levels relative to other services.

Ultimately, this research aims to investigate whether important differences exist among users with regard to economic behavior and media use in relation to convergence levels of devices and services. As the first phase for the ultimate research purpose, this research suggested criteria for assessing level of convergence of digital devices and services. Next, the research will investigate users who use those digital devices and services at varying levels of convergence.

As for limitations of the research, owing to lack of previous research for assessing level of convergence of digital technologies, many parts of the research process were dependent upon exploratory approaches such as professionals' opinions, and researcher's self-judgement. Additionally, for confirming reliability of research methodology, the researcher used opinions of 14 professionals only. Therefore, level of generalization may not be high and reasonable. So, in further research, we plan to utilize more opinions of professionals than in the first phase of research to provide more generalized results.

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