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A Study on Gap between Government's Institutions and Public People based on Ontology Inference about ICT Future Technology

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ABSTRACT

This paper analyzes how much the gap existed between the public group and expert group using future issues and future core technologies that are announced in government institutions based on ontology. We calculated gap with two groups' point of view, one is expert groups' ideas that are based on future hopeful technologies documents, and another is public people ideas that are based on documents of contest that is hosted by 'Ministry of Science, ICT and Future Planning (MSIP)', and 'Institute for Information & communications Technology Promotion (IITP)'. For calculating these, we suggested SDGM model. In the case of ETRI Meta-trend ICT Field, there is a little gap between expert group and public group, and another case that is XT (ETRI determined future technologies excluding ICT field) Field, the gap is increasing annually. Moreover, in the case of all ETRI Meta trend, the gap is bigger than ICT and XT field. We analyzed, also, KEIT's future issues for generalizing this model. The gap existed between two groups. Utilizing SDGM model of this paper, people can interpret easily how much the gap exists between future technologies and issues that are announced in institutions.

***Key words**: Gap Analysis, Ontology, Future Technology, Future Issue, Expert Group, Public group, SDGM Model.*

1. INTRODUCTION

The nation implemented many of policies for vitalizing "Creation Economy". In the center of "Creation Economy", country discover creative and innovative ideas that were suggested by people, and create added value in home, company, and nation using these ideas.

KEIT and ETRI tried a lot of effort to discover creative ideas of people that can be added value and commercialized, from 2011. However, the expression system difference and non-standardized method about future technology that suggested in institutions, are difficult for people to understand keyword and future technology.

In this paper, therefore, we analyzed the gap between future hopeful technologies that were proposed ETRI or KEIT and various ideas that were derived in 'Creation ICT Idea Camp' from 2011 to 2014. We would desire to confirm the point of view of future technology item that was proposed by ETRI and people's idea through this camp.

'Creation ICT Idea Camp' that was hosted by MSIP, 'Electronics and Telecommunications Research Institute

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(ETRI)', 'IITP' contests for spreading perceive of people about the policy of spreading ICT convergence and discovering promising technology and service that corresponding future. It is part of the strategy of spreading IT convergence of Korea government creating the new market by innovative technology and service, not following developed countries service model [1]. In this process, the work of ideas were accepted 1,291 during last four years like Table 1. In this research, we composed ontology database form by the contents of 1,291 ideas and future core technologies that announced by ETRI, KEIT. And we would desire to investigate that public people ideas corresponding and difference in what technology of future core technologies in ontology [2]-[4].

Table 1. Idea Documents Participating in Creation ICT Idea Camp

Year	Topic	Classification		Number of Idea	note
2011	"Imaginary as much as you like"	-		447	[5]
2012	"Imagination to Reality"	A Track	Proposing Hopeful Technology	202	[6]
		B Track	Imaginary Future	64	
2013	"Imagination to Reality"	A Track	Proposing Hopeful Technology	431	[7], [8]
	"Imaginary as much as you like"	B Track	Imaginary Future	117	
Total				1,261	

2. RELATED RESEARCH

2.1 Gap Analysis

The meaning of gap analysis means to provide means to connect the space when the space gap is existing between the places that the human lives in reality and human want, or to perform to decide the gap between a future condition that they want and real condition of specific domain or system [9]. [10] is a kind of gap. According to spread step of this concept, it composed as "realization → knowledge → implementation → devotion", and this concept spreading step connects as "realization gap → knowledge gap → implementation gap → devotion gap", this gap is influenced by data lifecycle. And we experimented that the community has how much the value each gap about the specific domain. For analyzing the gap in the case of [10], also, we suggested as six step those are ① domain modeling ② definition target value about the gap ③ extract dataset ④ gap analysis ⑤ documentation ⑥ test and contextualize. And we selected the domain that can analyze the gap like domain modeling, then provided the criteria to be possible to interpret the test about the gap to define target value of the gap. [11] is a method of gap analysis that suggested ① selection the "knows" gap trend, ②monitoring using triggers, ③ checking the potential gap, ④ redefine of the known gap, and ⑤ the action decision according to the gap.

The gap analysis decided the difference between current abilities and business order as identifying the gap between optimized assigns of input resource and current assigned level, or reduced degree of dangerous when the company or organization invest about technology or capacity. And it contains the contents of improvement and documentation. It can adapt various fields such as organization, a direction of the business, a process of business, processing information, education, etc.

The researches that related gap analysis was almost concentrated with needs between consumer and company in business part, or a methods or results that reduction danger when investing. There are few types of research like the platform for translating gap analysis and analysis research about the gap between expert group and public group in future hopeful technology domain like a purpose of our paper.

2.2 Extract Topic Keyword and Analysis Technology

For extracting the gap between the public group and expert group, we can derive the gap according to the criteria after the criteria and field that extracted the gap, were set. Currently, the extracted field of the gap and the criteria were not set between two groups as well as the field and criteria were not standardized or unified between expert groups. Thus, when considering the quantitative difference between two groups about specific criteria with the gap such as Fig 1, the task that composed and systematized field or criteria, must be preceded. For this, it needs overt classify about meaning or topic of words that having provided contents in two groups. Especially, we adapt the technology that can classify unstructured sentences to topic or meaning, because most of the contents that provided in two groups, explain future technology as unstructured sentences. Therefore, this paper adapted ontology technology to possible to compose correlation following text-mining, topic-mining, and classify system of topic-centered based on the machine-learning algorithm for this problem.

3. DESIGN GAP MODEL

This paper suggested Step Distance Gap Model (SDGM) for gap analysis between public groups and expert group. We cannot decide the degree of the gap between two groups as the difference and share of the scale of two data. Values of extracted data each item in two groups are small or the data is swamped with the specific item, so the scale of data that correspond another item, may have no meaning. For supplementing these data's character, this paper deducted the concept like Fig. 1.

3.1 Data Adjustment Process

In Fig. 1, the $Item_1$ rank of the public group is calculated 4, and $Item_1$ rank of the expert group is calculated 1. The step distance of two group is calculated 3 about this item; we can see the basic distance between two groups about$Item_1$. The concept of Fig. 1, it described data adjustment process for projecting gap model of the public group and expert group. First, the public group and expert group are composed as the same item, and there is a share of each group each item. Second, we calculate public group rank and expert group rank as criteria

each share of the item. Third, this rank is criteria to intuit share of the public group and expert group, the difference between two groups rank is a step distance. Fourth, each item weight is calculated as criteria each item's rank of two groups. Finally, we reflect step distance, share, and weight of each item, and calculate to compare criteria value of the public group and expert group.

Table 2. Explanation of Abbreviation

Abbreviation	Abbreviation Explain
EGC	Expert Group Count
PGC	Public Group Count
PGP	Public Group Percentage
EGP	Expert Group Percentage
PGR	Public Group Rank
EGR	Expert Group Rank
SD	Step Distance
PGW	Public Group Weight
EGW	Expert Group Weight
PGSW	Public Group Step by Weight)
EGSW	Expert Group Step by Weight
RD	Rate Distance
SDGM	Step Distance Gap Model
IV	Interval Value

We used abbreviations in the Tables. The following Table 2 is the explanation of abbreviations. The following Table 3 is a process of data adjustment. This is an algorithm for composing projection data of SDGM model. $PGSW_i, EGSW_i$ are calculated in the last process of an algorithm, utilize to calculate $SDGM_i$.

Table 3. Process of Data Adjustment

Definition 1 Process of Data adjustment

① $PGR_i \Longrightarrow Ranking\ by\ Public\ Group\ Rate\ Set$
$EGR_i \Longrightarrow Ranking\ by\ Expert\ Group\ Rate\ Set$

② $SD_i \Longrightarrow |PGR_i - EGR_i| (i\ is\ iTEM)$

③ $PGW_i \Longrightarrow 1 - ((PGR_i - 1) \times \frac{1}{Size\ of\ Item}$
$EGW_i \Longrightarrow 1 - ((EGR_i - 1) \times \frac{1}{Size\ of\ Item}$

④ $PGSW_i \Longrightarrow SD_i \times (PGW_i + EGP_i)$
$EGSW_i \Rightarrow SD_i \times (EGW_i + EGP_i)$

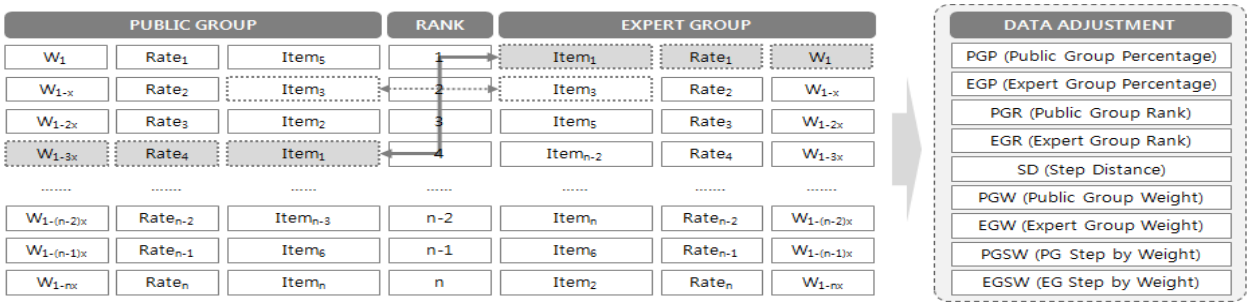

Fig. 1. The Basic Structure of Gap Analysis Model and Concept

Table 4. Data Preprocessing Value according to $SDGM_i$ Model and $SDGM_i, ISGM_i$ Value

No.	ETRI Meta Trend	PGP	EGP	PGR	EGR	SD_i	PGW_i	EGW_i	$PGSW_i$	$EGSW_i$	SDGM	$ISGM_i$	IV
1	5 Generation Mobile Communication	0.0760	0.2646	9	4	5	0.3333	0.7500	2.0466	5.0730	5.4702	0.1546	8
2	Network Connection	0.4517	0.4716	2	2	0	0.9167	0.9167	0.0000	0.0000	0.0000	1.0000	0
3	Mobilization Acceleration	0.2385	0.0995	3	8	5	0.8333	0.4167	5.3591	2.5808	5.9481	0.1439	8
4	Big Data	0.1396	0.2095	5	5	0	0.6667	0.6667	0.0000	0.0000	0.0000	1.0000	0
5	Cyber Security	0.0462	0.1587	11	6	5	0.1667	0.5833	1.0641	3.7101	3.8597	0.2058	7
6	Social Network	0.1119	0.0493	8	11	3	0.4167	0.1667	1.5857	0.6478	1.7130	0.3686	6
7	Real-Time Video Big Data Analysis	0.0410	0.0529	12	10	2	0.0833	0.2500	0.2487	0.6058	0.6549	0.6043	3
8	Wearable Communication Device	0.1814	0.0437	4	12	8	0.7500	0.0833	7.4512	1.0165	7.5202	0.1174	8
9	Person-Centered UX/UI	1.3837	0.9917	1	1	0	1.0000	1.0000	0.0000	0.0000	0.0000	1.0000	0
10	Next Generation Computing	0.1325	0.4283	6	3	3	0.5833	0.8333	2.1474	3.7849	4.3516	0.1869	8
11	Cloud	0.1240	0.1329	7	7	0	0.5000	0.5000	0.0000	0.0000	0.0000	1.0000	0
12	Hologram Production and Play System	0.0737	0.0973	10	9	1	0.2500	0.3333	0.3237	0.4306	0.5387	0.6499	3
						2.667					8.3051	0.1075	4.250

3.2 SDGM Model

SDGM model is a processing model as a gap that is calculated the line segment that connects two points to the distance between two groups about the specific item, after the value of vector space $PGSW_i, EGSW_i$ of each specific item in public group and expert group, put as the point of two-dimensional. For this, we find the orthogonal point to draw orthographic line segment in calculated $PGSW_i, EGSW_i$. After the baseline assign $EGSW_i$, and the height assign $PGSW_i$ as criteria orthographic point, we calculate the gap $SDGM_i$

between items of two groups using Euclidean Distance Measure. After that, we calculate $ISGM_i$ that is normalization value between 0 and 1. If the $ISGM_i$ value is 1, it means that two of groups correspond, if the value is 0, it means that two of groups are different.

Table 4 defines the $SDGM_i$ model to calculate the gap size of two groups using calculated $PGSW_i, EGSW_i$ according to Table 3. It can know the gap between groups intuitionally because it is calculated merely the distance between two groups as a gap using Euclidean Distance Measure in the vector space. The left picture of Fig. 2 shows that it can be calculated the distance when $PGSW_i$ point and $EGSW_i$ point connect for calculating $SDGM_i$. The right picture shows a method to calculate distance between groups using the value of the specific item that is calculated actually. The distance ($SDGM_i$) of $PGSW_i, EGSW_i(4.2784, 2.2362)$ is 4.828.

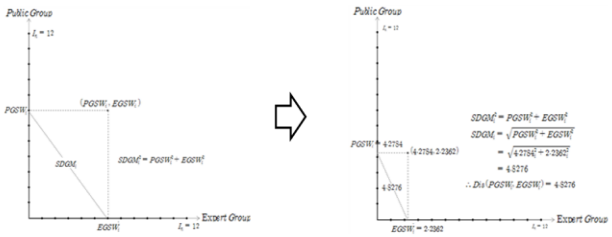

Fig. 2. The Gap between Public group and Expert Group

Table 5. The Definition of $SDGM_i$ and $ISGM_i$

Definition 2 $SDGM_i$ and $ISGM_i$
① $\boldsymbol{SDGM_i^2 = (0 - PGSW_i)^2 + (0 - EGSW_i^2)}$
$\rightarrow \boldsymbol{SDGM_i = \sqrt{(0 - PGSW_i)^2 + (0 - EGSW_i)^2}}$
② $\boldsymbol{ISGM_i = \frac{1}{(1+SDGM_i)}}$

There was relative compare problem because the $SDGM_i$ interval value in each item was $0 \leq SDGM_i \leq \sqrt{Max(0 - PGSW_i{}^2 + Max(0 - EGSW^i)^2}$ in each field. Therefore, it needs to normalize this value. If the $SDGM_i$ substitute to the $ISGM_i$ formulation, it can get $0 \leq SDGM_i \leq 1$. Table 5 is a calculated result that is the trend of ICT field announced in ETRI using Table 3, and Table 4. In Table 5, the right-most column Gap-Intensity (GI) is an interval value according to $ISGM_i$, it is decided intensity value following

Table 6. Gap Tracking about Item of ETRI Meta-trend ICT Field in Each Year

No.	ETRI's ICT Trend	2011		2012		2013		TREND		YPSGM	YESGM	APSGM$_i$	$AEGM_i$	PIV	EIV
		$PGSW_i$	$EGSW_i$	$PGSW_i$	$EGSW_i$	$PGSW_i$	$EGSW_i$	$PGSW_i$	$EGSW_i$						
1	5 Generation Mobile Communication	0.7500	8.6571	1.6667	3.7500	0.6667	0.7500	2.0466	5.0730	1.3566	5.7515	0.4243	0.1481	5	8
2	Network Connection	2.1641	1.6714	0.9167	0.8333	0.0000	0.9167	0.0000	0.0000	1.5480	0.8422	0.3925	0.5428	6	4
3	Mobilization Acceleration	7.1897	1.4476	1.5000	1.1667	4.1667	0.4167	5.3591	2.5808	6.2837	0.8009	0.1373	0.5553	8	4
4	Big Data	0.5231	0.6262	0.5833	0.6667	0.7500	0.8333	0.0000	0.0000	0.1772	0.1715	0.8495	0.8536	1	1
5	Cyber Security	1.3077	3.6190	0.3333	1.6667	1.5000	0.7500	1.0641	3.7101	1.5200	2.1569	0.3968	0.3168	6	6
6	Social Network	0.0000	0.0000	1.0000	0.2500	3.5000	0.0833	1.5857	0.6478	2.6926	0.3005	0.2708	0.7690	7	2
7	Real-Time Video Big Data Analysis	0.3410	0.7238	1.2500	0.5000	0.0833	0.1667	0.2487	0.6058	1.4790	0.4015	0.4034	0.7135	5	2
8	Wearable Communication Device	5.0436	0.5833	4.1667	2.0833	0.8333	0.2500	7.4512	1.0165	3.4468	2.3688	0.2249	0.2968	7	7
9	Person-Centered UX/UI	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000	0.0000	0.0000	1.0000	1.0000	0.5000	0	4
10	Next Generation Computing	1.6231	2.1190	2.3333	6.4167	1.5000	0.7500	2.1474	3.7849	1.0949	7.1120	0.4773	0.1233	5	8
11	Cloud	0.8718	1.2524	4.5000	1.5000	1.6667	0.7500	0.0000	0.0000	4.6034	0.7898	0.1785	0.5587	8	4
12	Hologram Production and Play System	0.0000	0.0000	0.5833	0.5000	0.2500	0.3333	0.3237	0.4306	0.6719	0.5270	0.5981	0.6549	4	3
		1.6512	1.7250	1.5694	1.6111	1.2431	0.5833	1.6855	1.4875	9.4985	9.8720	0.0953	0.0920	5.17	4.42

Table 6, and decided intensity value can be criteria to interpret how much the gap existing related item in the specific field.

Fig. 3 is a gap intensity distribution expression after calculating IV that separate strength of 10 between 0 and 0.9 in Table 6 $ISGM_i$ value. We can decide the intensity of gap according to put location median as a center the value 0.5 of the bottom of the picture. If the gap exists, the center value moves left of 0.5, if the gap does not exist, the center value move right of 0.5. So we can decide the intensity of gap along with seeing the location of center-value.

The calculated value the intensity of gap $0 \leq ISGM_i < 1$ in Table 6, it can accumulate the frequency. For example, the value of IV 8 has frequency of 4, and value of IV 0 has the frequency of 4. To process this value to the percentage, we can substitute in histogram frame like Fig. 3.

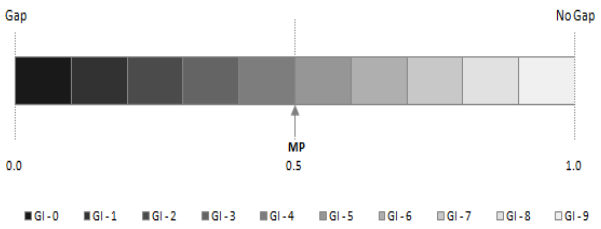

Fig. 3. Standard Gap Intensity Histogram Frame

Table 7. $ISGM_i$ Value Intensity in each section

Section	Gap Intensity	Section	Gap Intensity
$0 \le ISGM_i < 0.1$	0.9	$0.5 < ISGM_i \le 0.6$	0.4
$0.1 < ISGM_i \le 0.2$	0.8	$0.6 < ISGM_i \le 0.7$	0.3
$0.2 < ISGM_i \le 0.3$	0.7	$0.7 < ISGM_i \le 0.8$	0.2
$0.3 < ISGM_i \le 0.4$	0.6	$0.8 < ISGM_i \le 0.9$	0.1
$0.4 < ISGM_i \le 0.5$	0.5	$0.9 < ISGM_i \le 1.0$	0.0

4. GAP ANALYSIS BETWEEN GROUPS

This chapter describes that the gap intensity calculated in each specific institution and field of meta-system according to $SDGM_i$ model that suggested the previous chapter. After continue various interpret, suggested gap analysis model shows useful to analyze between expert groups or public group and expert group.

For this, we select the future issue that is announced in KEIT, and future technology meta-trend that is announced in ETRI from 2011 to 2013 as criteria for gap analysis. Future technology meta-trend of ETRI composed ICT field, XT field, all of ETRI meta-trend, and grouping field similar topic using inference function like $?x \rightarrow associatedCategory \rightarrow ?y$, and we interpreted gap intensity between two groups as a criteria future-issue of KEIT.

4.1 ETRI Meta-trend ICT Field

ICT field of ETRI composed of 12 of items, and the result that is calculated suggested method in our paper, is calculated $SD_i, PGW_i, EGW_i, PGSW_i, EGSW_i, SDGM_i, ISGM_i,$ and IV_i according to Table 4 like Table 5. Bottom of Table value $SDGM_{total}$ is calculated all of the $PGSW_i, EGSW_i$ value using Euclidean Distance Measure, $ISGM_{average}$ is a normalization value of $SDGM_{total}$, $IV_{average}$ is an averaging all of the IV_i. Table 7 is $ISGM_i$, and IV_i summarized table from 2011 to 2013. $ISGM_i$ of the 2012 year is the smallest than other years; it means the gap intensity is the highest in the 2012 year.

Table 8 is tracking gap result each year between 2012 and 2013, and 2011 and 2012 about each item of ICT field. Moreover, this is $PGSW_i, EGSW_i$ value of items and the gap in each year between the public group and expert group, normalized gap, and gap intensity. Table 8 is a result that is composed of gap intensity frequency in Table 7 and Table 8. The left side of Table 9 is a result that is calculated as a criteria item each intensity frequency. Another is a result that is calculated frequency as criteria each year gap.

Table 8. $ISGM_i$ and IV_i of ETRI Meta-trend ICT Field

No.	ETRI's ICT Trend	2011		2012		2013		TREND	
		$ISGM_i$	IV	$ISGM_i$	IV	$ISGM_i$	IV	$ISGM_i$	IV
1	5 Generation Mobile Communication	0.1032	8	0.1959	8	0.4991	5	5.4702	8
2	Network Connection	0.2678	7	0.4467	5	1.0000	0	0.0000	0
3	Mobilization Acceleration	0.1200	8	0.3448	6	0.1767	8	5.9481	8
4	Big Data	0.5507	4	0.5303	4	0.4714	5	0.0000	0
5	Cyber Security	0.2063	7	0.3704	6	0.1741	8	3.8597	7
6	Social Network	1.0000	0	0.4924	5	0.2205	7	1.7130	6
7	Real-Time Video Big Data Analysis	0.5555	4	0.4262	5	0.8429	1	0.6549	3
8	Wearable Communication Device	0.1645	8	0.1767	8	0.5071	4	7.5202	8
9	Person-Centered UX/UI	1.0000	0	1.0000	0	1.0000	0	0.0000	0
10	Next Generation Computing	0.2725	7	0.1278	8	0.2700	7	4.3516	8
11	Cloud	0.3959	6	0.1741	8	0.1959	8	0.0000	0
12	Hologram Production and Play System	1.0000	0	0.5655	4	0.7059	2	0.5387	3
		0.1075	4.250	0.1406	5.583	0.1605	4.583	0.1075	4.250

Table 9. Each Gap Intensity Frequency of ETRI Meta-trend ICT Field

IV	2011	2012	2013	SUM	RATE
GI - 0	3	1	2	6	0.17
GI - 1	0	0	1	1	0.03
GI - 2	0	0	1	1	0.03
GI - 3	0	0	0	0	0.00
GI - 4	2	2	1	5	0.14
GI - 5	0	3	2	5	0.14
GI - 6	1	2	0	3	0.08
GI - 7	3	0	2	5	0.14
GI - 8	3	4	3	10	0.28
GI - 9	0	0	0	0	0.00
	12	12	12	36	1

IV	PIV	EIV	PIV RATE	EIV RATE
GI - 0	1	0	0.08	0.00
GI - 1	1	1	0.08	0.08
GI - 2	0	2	0.00	0.17
GI - 3	0	1	0.00	0.08
GI - 4	1	4	0.08	0.33
GI - 5	3	0	0.25	0.00
GI - 6	2	1	0.17	0.08
GI - 7	2	1	0.17	0.08
GI - 8	2	2	0.17	0.17
GI - 9	0	0	0.00	0.00
	12	12	1	1

Table 10. ETRI ICT Field Data Adjustment, $SDGM_i, ISGM_i, and\ IV_i$ – 2011

No.	ETRI Meta Trend	PGP	EGP	PGR	EGR	SD_i	PGW_i	EGW_i	$PGSW_i$	$EGSW_i$	SDGM	$ISGM_i$	IV
1	5 Generation Mobile Communication	0.0000	0.1286	12	3	9	0.0833	0.8333	0.7500	8.6571	8.6896	0.103	8
2	Network Connection	0.1654	0.0857	2	4	2	0.9167	0.7500	2.1641	1.6714	2.7344	0.268	7
3	Mobilization Acceleration	0.0654	0.0143	3	11	8	0.8333	0.1667	7.1897	1.4476	7.3340	0.120	8
4	Big Data	0.0231	0.0429	7	6	1	0.5000	0.5833	0.5231	0.6262	0.8159	0.551	4
5	Cyber Security	0.0115	0.0571	10	5	5	0.2500	0.6667	1.3077	3.6190	3.8481	0.206	7
6	Social Network	0.0385	0.0429	6	6	0	0.5833	0.5833	0.0000	0.0000	0.0000	1.000	0
7	Real-Time Video Big Data Analysis	0.0038	0.0286	11	9	2	0.1667	0.3333	0.3410	0.7238	0.8001	0.556	4
8	Wearable Communication Device	0.0538	0.0000	5	12	7	0.6667	0.0833	5.0436	0.5833	5.0772	0.165	8
9	Person-Centered UX/UI	0.5423	0.3857	1	1	0	1.0000	1.0000	0.0000	0.0000	0.0000	1.000	0
10	Next Generation Computing	0.0615	0.1429	4	2	2	0.7500	0.9167	1.6231	2.1190	2.6692	0.273	7
11	Cloud	0.0192	0.0429	8	6	2	0.4167	0.5833	0.8718	1.2524	1.5259	0.396	6
12	Hologram Production and Play System	0.0154	0.0286	9	9	0	0.3333	0.3333	0.0000	0.0000	0.0000	1.000	0
						3.167					11.0347	0.083	4.917

Table 11. ETRI ICT Field Data Adjustment, $SDGM_i, ISGM_i, and\ IV_i$ – 2012

No.	ETRI Meta Trend	PGP	EGP	PGR	EGR	SD_i	PGW_i	EGW_i	$PGSW_i$	$EGSW_i$	SDGM	$ISGM_i$	IV
1	5 Generation Mobile Communication	0.0178	0.0632	9	4	5	0.3333	0.7500	1.6667	3.7500	4.1037	0.196	8
2	Network Connection	0.1420	0.1782	2	3	1	0.9167	0.8333	0.9167	0.8333	1.2388	0.447	5
3	Mobilization Acceleration	0.0592	0.0402	4	6	2	0.7500	0.5833	1.5000	1.1667	1.9003	0.345	6
4	Big Data	0.0355	0.0575	6	5	1	0.5833	0.6667	0.5833	0.6667	0.8858	0.530	4
5	Cyber Security	0.0118	0.0287	12	8	4	0.0833	0.4167	0.3333	1.6667	1.6997	0.370	6
6	Social Network	0.0178	0.0000	9	12	3	0.3333	0.0833	1.0000	0.2500	1.0308	0.492	5
7	Real-Time Video Big Data Analysis	0.0296	0.0115	8	11	3	0.4167	0.1667	1.2500	0.5000	1.3463	0.426	5
8	Wearable Communication Device	0.0769	0.0287	3	8	5	0.8333	0.4167	4.1667	2.0833	4.6585	0.177	8
9	Person-Centered UX/UI	0.4970	0.3276	1	1	0	1.0000	1.0000	0.0000	0.0000	0.0000	1.000	0
10	Next Generation Computing	0.0178	0.2126	9	2	7	0.3333	0.9167	2.3333	6.4167	6.8277	0.128	8
11	Cloud	0.0592	0.0172	4	10	6	0.7500	0.2500	4.5000	1.5000	4.7434	0.174	8
12	Hologram Production and Play System	0.0355	0.0345	6	7	1	0.5833	0.5000	0.5833	0.5000	0.7683	0.566	4
						3.167					6.1146	0.141	5.583

Table 12. ETRI ICT Field Data Adjustment, $SDGM_i, ISGM_i, and\ IV_i$ - 2013

No.	ETRI Meta Trend	PGP	EGP	PGR	EGR	SD_i	PGW_i	EGW_i	$PGSW_i$	$EGSW_i$	SDGM	$ISGM_i$	IV
1	5 Generation Mobile Communication	0.0582	0.0728	5	4	1	0.6667	0.7500	0.6667	0.7500	1.0035	0.499	5
2	Network Connection	0.1443	0.2077	2	2	0	0.9167	0.9167	0.0000	0.0000	0.0000	1.000	0
3	Mobilization Acceleration	0.1139	0.0450	3	8	5	0.8333	0.4167	4.1667	2.0833	4.6585	0.177	8
4	Big Data	0.0810	0.1092	4	3	1	0.7500	0.8333	0.7500	0.8333	1.1211	0.471	5
5	Cyber Security	0.0228	0.0728	10	4	6	0.2500	0.7500	1.5000	4.5000	4.7434	0.174	8
6	Social Network	0.0557	0.0064	6	12	6	0.5833	0.0833	3.5000	0.5000	3.5355	0.220	7
7	Real-Time Video Big Data Analysis	0.0076	0.0128	12	11	1	0.0833	0.1667	0.0833	0.1667	0.1863	0.843	1
8	Wearable Communication Device	0.0506	0.0150	8	10	2	0.4167	0.2500	0.8333	0.5000	0.9718	0.507	4
9	Person-Centered UX/UI	0.3443	0.2784	1	1	0	1.0000	1.0000	0.0000	0.0000	0.0000	1.000	0
10	Next Generation Computing	0.0532	0.0728	7	4	3	0.5000	0.7500	1.5000	2.2500	2.7042	0.270	7
11	Cloud	0.0456	0.0728	9	4	5	0.3333	0.7500	1.6667	3.7500	4.1037	0.196	8
12	Hologram Production and Play System	0.0228	0.0343	10	9	1	0.2500	0.3333	0.2500	0.3333	0.4167	0.706	2
						2.583					5.2321	0.160	4.583

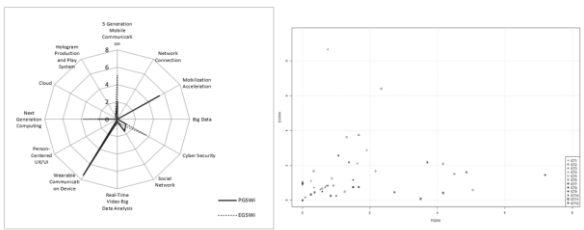

Fig. 4. Each items $PGSW_i, EGSW_i$ of ICT Field and Vector Space Coordinate

Fig. 4 is an output that is the difference between $PGSW_i, EGSW_i$ of each item in the trend of ICT field using radial shape graph. The right of the figure is an output that is the distribution of $PGSW_i, EGSW_i$ values in two-dimensional vector space. These distribution are basics to decide $SDGM_i$

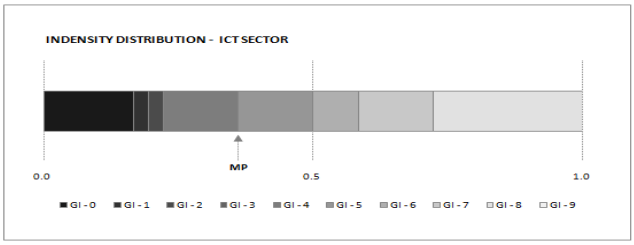

Fig. 5. Gap Intensity Histogram of ICT Field

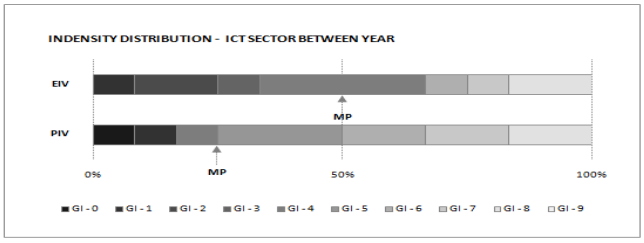

Fig. 6. Gap Intensity Histogram between Public group and Expert Group in Each Year of ICT Field

Looking gap intensity histogram of Fig. 5 and Fig. 6 about ICT trend of ETRI, median value can be known that the central value located left side from 0.5. In the ICT sector case, it can interpret intuitionally a little gap between the public group and expert group.

Gap analysis result in Fig. 6 in each year is that the median value is same as the central value in the expert group case. This is difficult to interpret that the gap exists. Moreover, the median value is located with left side rather than central value in public group case. Thus, the median value is located with the gap exists.

4.2 ETRI Meta-trend XT Field

XT Field that suggested in ETRI, is composed of 11 items that are suggested future hopeful technology to trend in the field of BT, CT, NT, and so on except ICT Field. The gap calculation result of two groups is Table 13, and Table 14 about XT trend.

Table 13. Items of ETRI Meta Trend XT Field about Gap Tracking in Each Year

No.	ETRI's XT Trend	2011		2012		2013		TREND		YPSGM	YESGM	$APSGM_i$	$AEGM_i$	PIV	EIV
		$PGSW_i$	$EGSW_i$	$PGSW_i$	$EGSW_i$	$PGSW_i$	$EGSW_i$	$PGSW_i$	$EGSW_i$						
1	3D Print	0.0000	0.0000	0.0000	0.0000	1.1757	0.2807	0.0000	0.0000	1.1757	0.2807	0.4596	0.7808	5	2
2	Social Research and Climate Change Modeling for Predicting Social, Economy, Environment	0.3823	0.2849	0.0000	0.0000	0.3045	1.2186	0.0000	0.0000	0.4887	1.2514	0.6717	0.4442	3	5
3	Global Cyber Attack and Personal Information Collection Respond	0.3823	0.5033	0.7669	0.4131	0.5879	1.5232	0.3253	0.4904	0.4242	1.1137	0.7021	0.4731	2	5
4	Nano Fusion	1.1282	4.8758	1.4824	2.3897	1.1757	2.8221	1.2920	2.5806	0.4686	2.5234	0.6809	0.2838	3	7
5	Brain Research	1.4568	0.5455	1.3915	1.0081	2.6878	1.8279	2.1410	1.1582	1.2979	0.9413	0.4352	0.5151	5	4
6	Robot Technology	2.0954	1.2007	0.6958	0.7966	2.0681	1.2186	0.8109	0.6939	1.9602	0.5843	0.3378	0.6312	6	3
7	Smart Health Care	0.0000	0.0000	1.6922	1.1998	1.1494	0.9352	1.4421	1.2336	1.7771	1.2287	0.3601	0.4487	6	5
8	Smart City	7.2360	3.0322	1.3069	1.1170	4.1555	2.5089	6.4179	3.3156	6.5779	2.3675	0.1320	0.2970	8	7
9	Smart Car	1.8351	1.4191	5.8596	1.8740	4.8089	1.2345	4.6007	2.3650	4.1594	0.7848	0.1938	0.5603	8	4
10	Energy Supply and Next Generation Battery	2.4054	3.8415	1.0972	1.0063	2.9817	7.4681	3.0970	5.1399	2.2941	7.0564	0.3036	0.1241	6	8
11	Environment and Disaster Respond	1.3970	1.9534	2.6841	8.6980	2.0681	3.4214	2.9473	7.7079	1.4269	8.5634	0.4120	0.1046	5	8
		1.6653	1.6051	1.5433	1.6821	2.1057	2.2236	2.0976	2.2441	8.8641	11.8885	0.1014	0.0776	3.25	3.25

Table 14. $ISGM_i, IV_i$ of ETRI Meta Trend XT Field

No	ETRI's XT Trend	2011		2012		2013		TREND	
		$ISGM_i$	IV	$ISGM_i$	IV	$ISGM_i$	IV	$ISGM_i$	IV
1	3D Print	1.0000	0	1.0000	0	0.4527	5	1.0000	0
2	Social Research and Climate Change Modeling for Predicting Social, Economy, Environment	0.6772	3	1.0000	0	0.4433	5	1.0000	0
3	Global Cyber Attack and Personal Information Collection Respond	0.6127	3	0.5344	4	0.3798	6	0.6295	3
4	Nano Fusion	0.1665	8	0.2623	7	0.2465	7	0.2573	7
5	Brain Research	0.3913	6	0.3679	6	0.2353	7	0.2912	7
6	Robot Technology	0.2928	7	0.4860	5	0.2941	7	0.4837	5
7	Smart Health Care	1.0000	0	0.3253	6	0.4029	5	0.3451	6
8	Smart City	0.1131	8	0.3677	6	0.1708	8	0.1216	8
9	Smart Car	0.3012	6	0.1398	8	0.1677	8	0.1620	8
10	Energy Supply and Next Generation Battery	0.1808	8	0.4018	5	0.1106	8	0.1428	8
11	Environment and Disaster Respond	0.2940	7	0.0990	9	0.2001	7	0.1081	8
		0.1430	5.091	0.1203	5.091	0.1308	6.636	0.1308	5.46

Table 15. Gap Intensity Frequency of ETRI Meta Trend XT Field

IVF	2011	2012	2013	SUM	RATE
GI - 0	2	2	0	4	0.12
GI - 1	0	0	0	0	0.00
GI - 2	0	0	0	0	0.00
GI - 3	2	0	0	2	0.06
GI - 4	0	1	0	1	0.03
GI - 5	0	2	3	5	0.15
GI - 6	2	3	1	6	0.18
GI - 7	2	1	4	7	0.21
GI - 8	3	1	3	7	0.21
GI - 9	0	1	0	1	0.03
	11	11	11	33	1

IVF	PIV	EIV	PIV RATE	EIV RATE
GI - 0	0	0	0.00	0.00
GI - 1	0	0	0.00	0.00
GI - 2	1	1	0.09	0.09
GI - 3	2	1	0.18	0.09
GI - 4	0	2	0.00	0.18
GI - 5	3	3	0.27	0.27
GI - 6	3	0	0.27	0.00
GI - 7	0	2	0.00	0.18
GI - 8	2	2	0.18	0.18
GI - 9	0	0	0.00	0.00
	11	11	1	1

The biggest gap items of $PGSW_i, EGSW_i$ appeared "Environment and Correspond to Disaster" and "Smart City" items. In this two items cases, thus, they mean that the two of groups had the difference in the point of view, and $PGSW_i, EGSW_i$ that is distributed in vector space, it showed that they had a large distance between the points in the part of cases.

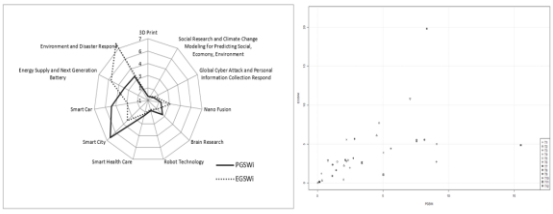

Fig. 7. $PGSW_i, EGSW_i$ in Each Items of XT Field and Vector Space Coordinate

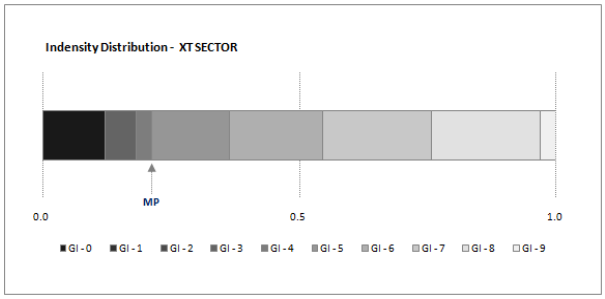

Fig. 8. Gap Intensity Histogram of XT Field

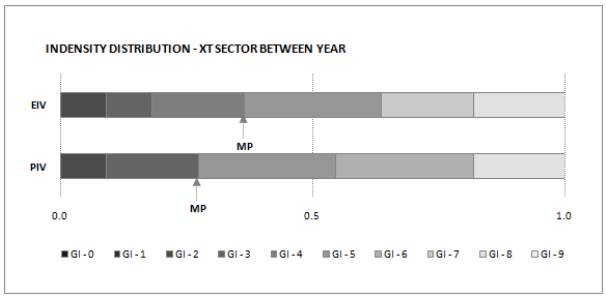

Fig. 9. Gap Intensity Histogram between Public group and Expert Group in Each Year of XT Field

Table 16. ETRI XT Field Data Adjustment, $SDGM_i, ISGM_i, and\ IV_i$ – Trend

No.	ETRI Meta Trend	PGP	EGP	PGR	EGR	SD_i	PGW_i	EGW_i	$PGSW_i$	$EGSW_i$	$SDGM_i$	$ISGM_i$	IV_i
1	3D Print	0.0444	0.0126	11	11	0	0.0909	0.0909	0.0000	0.0000	0.0000	1.000	0
2	Social Research and Climate Change Modeling for Predicting Social, Economy, Environment	0.0490	0.0993	10	10	0	0.1818	0.1818	0.0000	0.0000	0.0000	1.000	0
3	Global Cyber Attack and Personal Information Collection Respond	0.0526	0.1267	9	8	1	0.2727	0.3636	0.3253	0.4904	0.5884	0.630	3
4	Nano Fusion	0.0670	0.2238	8	5	3	0.3636	0.6364	1.2920	2.5806	2.8859	0.257	7
5	Brain Research	0.1682	0.1133	6	9	3	0.5455	0.2727	2.1410	1.1582	2.4342	0.291	7
6	Robot Technology	0.1745	0.1484	5	6	1	0.6364	0.5455	0.8109	0.6939	1.0673	0.484	5
7	Smart Health Care	0.5330	0.4154	2	3	1	0.9091	0.8182	1.4421	1.2336	1.8977	0.345	6
8	Smart City	1.1393	0.3779	1	4	3	1.0000	0.7273	6.4179	3.3156	7.2238	0.122	8
9	Smart Car	0.3320	0.1367	3	7	4	0.8182	0.4545	4.6007	2.3650	5.1730	0.162	8
10	Energy Supply and Next Generation Battery	0.3051	0.7133	4	1	3	0.7273	1.0000	3.0970	5.1399	6.0008	0.143	8
11	Environment and Disaster Respond	0.1349	0.6325	7	2	5	0.4545	0.9091	2.9473	7.7079	8.2522	0.108	8
		3.0000	3.0000			2.2					6.6460	0.131	5.455

Table 17. ETRI XT Field Data Adjustment, $SDGM_i, ISGM_i, and\ IV_i$ – 2011

No.	ETRI Meta Trend	PGP	EGP	PGR	EGR	SD_i	PGW_i	EGW_i	$PGSW_i$	$EGSW_i$	$SDGM_i$	$ISGM_i$	IV_i
1	3D Print	0.0062	0.0000	10	10	0	0.1818	0.1818	0.0000	0.0000	0.0000	1.000	0
2	Social Research and Climate Change Modeling for Predicting Social, Economy, Environment	0.0186	0.0122	8	9	1	0.3636	0.2727	0.3823	0.2849	0.4768	0.677	3
3	Global Cyber Attack and Personal Information Collection Respond	0.0186	0.0488	8	7	1	0.3636	0.4545	0.3823	0.5033	0.6320	0.613	3
4	Nano Fusion	0.0062	0.0854	10	4	6	0.1818	0.7273	1.1282	4.8758	5.0046	0.167	8
5	Brain Research	0.0311	0.0000	7	10	3	0.4545	0.1818	1.4568	0.5455	1.5556	0.391	6
6	Robot Technology	0.0621	0.0366	5	8	3	0.6364	0.3636	2.0954	1.2007	2.4150	0.293	7
7	Smart Health Care	0.1739	0.2439	2	2	0	0.9091	0.9091	0.0000	0.0000	0.0000	1.000	0
8	Smart City	0.4472	0.0610	1	6	5	1.0000	0.5455	7.2360	3.0322	7.8456	0.113	8
9	Smart Car	0.0994	0.0732	3	5	2	0.8182	0.6364	1.8351	1.4191	2.3198	0.301	6
10	Energy Supply and Next Generation Battery	0.0745	0.2805	4	1	3	0.7273	1.0000	2.4054	3.8415	4.5324	0.181	8
11	Environment and Disaster Respond	0.0621	0.1585	5	3	2	0.6364	0.8182	1.3970	1.9534	2.4015	0.294	7
		1.0000	1.0000			2.4					5.9931	0.143	5.091

Table 18. ETRI XT Field Data Adjustment, $SDGM_i, ISGM_i, and\ IV_i$ – 2012

No.	ETRI Meta Trend	PGP	EGP	PGR	EGR	SD_i	PGW_i	EGW_i	$PGSW_i$	$EGSW_i$	$SDGM_i$	$ISGM_i$	IV_i
1	3D Print	0.0099	0.0099	11	11	0	0.0909	0.0909	0.0000	0.0000	0.0000	1.000	0
2	Social Research and Climate Change Modeling for Predicting Social, Economy, Environment	0.0198	0.0446	8	8	0	0.3636	0.3636	0.0000	0.0000	0.0000	1.000	0
3	Global Cyber Attack and Personal Information Collection Respond	0.0198	0.0248	8	10	2	0.3636	0.1818	0.7669	0.4131	0.8711	0.534	4
4	Nano Fusion	0.0396	0.0693	7	4	3	0.4545	0.7273	1.4824	2.3897	2.8122	0.262	7
5	Brain Research	0.0594	0.0495	5	7	2	0.6364	0.4545	1.3915	1.0081	1.7183	0.368	6
6	Robot Technology	0.0594	0.0693	5	4	1	0.6364	0.7273	0.6958	0.7966	1.0577	0.486	5
7	Smart Health Care	0.1188	0.0545	4	6	2	0.7273	0.5455	1.6922	1.1998	2.0744	0.325	6
8	Smart City	0.3069	0.2079	1	2	1	1.0000	0.9091	1.3069	1.1170	1.7192	0.368	6
9	Smart Car	0.1584	0.0396	3	9	6	0.8182	0.2727	5.8596	1.8740	6.1520	0.140	8
10	Energy Supply and Next Generation Battery	0.1881	0.1881	2	3	1	0.9091	0.8182	1.0972	1.0063	1.4888	0.402	5
11	Environment and Disaster Respond	0.0198	0.2426	8	1	7	0.3636	1.0000	2.6841	8.6980	9.1027	0.099	9
		1.0000	1.0000			2.3					7.3106	0.120	5.091

Table 19. ETRI XT Field Data Adjustment, $SDGM_i, ISGM_i, and\ IV_i$ – 2013

No.	ETRI Meta Trend	PGP	EGP	PGR	EGR	SD_i	PGW_i	EGW_i	$PGSW_i$	$EGSW_i$	$SDGM_i$	$ISGM_i$	IV_i
1	3D Print	0.0283	0.0027	8	11	3	0.3636	0.0909	1.1757	0.2807	1.2088	0.453	5
2	Social Research and Climate Change Modeling for Predicting Social, Economy, Environment	0.0106	0.0426	11	8	3	0.0909	0.3636	0.3045	1.2186	1.2560	0.443	5
3	Global Cyber Attack and Personal Information Collection Respond	0.0141	0.0532	10	7	3	0.1818	0.4545	0.5879	1.5232	1.6327	0.380	6
4	Nano Fusion	0.0212	0.0691	9	5	4	0.2727	0.6364	1.1757	2.8221	3.0572	0.246	7
5	Brain Research	0.0777	0.0638	3	6	3	0.8182	0.5455	2.6878	1.8279	3.2504	0.235	7
6	Robot Technology	0.0530	0.0426	5	8	3	0.6364	0.3636	2.0681	1.2186	2.4004	0.294	7
7	Smart Health Care	0.2403	0.1170	2	3	1	0.9091	0.8182	1.1494	0.9352	1.4818	0.403	5
8	Smart City	0.3852	0.1090	1	4	3	1.0000	0.7273	4.1555	2.5089	4.8542	0.171	8
9	Smart Car	0.0742	0.0239	4	10	6	0.7273	0.1818	4.8089	1.2345	4.9648	0.168	8
10	Energy Supply and Next Generation Battery	0.0424	0.2447	7	1	6	0.4545	1.0000	2.9817	7.4681	8.0413	0.111	8
11	Environment and Disaster Respond	0.0530	0.2314	5	2	3	0.6364	0.9091	2.0681	3.4214	3.9979	0.200	7
		1.0000	1.0000			3.5					6.6464	0.131	6.636

We can know the median value lean to left side from the center value when looking gap intensity histogram of XT trend of ETRI. XT field of ETRI had some gaps between two groups. The public group's gap is bigger than expert group's gap in two of groups' gap in each year of XT trend of ETRI. Thus, the gap is not very big, it appears that the gap increase gradually each year. Table 16 to Table 19 is a result of $SDGM_i$, and IV_i, and the data adjustment value about ETRI XT field.

Table 20. ETRI Meta Trend $ISGM_i, IV_i$

No.	ETRI Meta Trend	2011		2012		2013		TREND	
		$ISGM_i$	IV	$ISGM_i$	IV	$ISGM_i$	IV	$ISGM_i$	IV
1	5 Generation Mobile Communication	0.038	9	0.153	8	0.507	4	0.0552	9
2	Network Connection	0.160	8	0.414	5	0.152	8	0.3663	6
3	Mobilization Acceleration	0.086	9	0.135	8	0.069	9	0.0630	9
4	Cyber Security	0.087	9	0.301	6	0.108	8	0.1141	8
5	Global Cyber Attack and Personal Information Collection Respond	1.000	0	0.070	9	0.246	7	0.1181	8
6	Big Data	0.139	8	0.419	5	0.298	7	0.1467	8
7	Cloud	0.128	8	0.096	9	0.167	8	0.4260	5
8	Real-Time Video Big Data Analysis	0.158	8	0.275	7	1.000	0	1.0000	0
9	Social Research and Climate Change Modeling for Predicting Social, Economy, Environment	0.341	6	0.250	7	0.311	6	0.2812	7
10	Self-Organizing Information Share Platform	0.107	8	0.275	7	0.217	7	0.0806	9
11	Social Network	0.227	7	0.359	6	0.072	9	0.3033	6
12	Hologram Production and Play System	0.234	7	0.458	5	1.000	0	0.5134	4
13	Person-Centered UX/UI	1.000	0	1.000	0	1.000	0	1.0000	0
14	Pass Over Five Sense Social UX/UI	0.092	9	0.129	8	0.123	8	0.0784	9
15	Wearable Communication Device	0.113	8	0.091	9	0.142	8	0.0640	9
16	Context-aware X-Computing	0.038	9	0.114	8	0.157	8	0.0481	9
17	Next Generation Computing	0.064	9	0.034	9	0.355	6	0.0426	9
18	Energy Supply and Next Generation Battery	0.219	7	0.220	7	0.046	9	0.1141	8
19	Environment and Disaster Respond	0.333	6	0.165	8	0.054	9	0.1337	8
20	Micro/Metro Energy Gird	0.143	8	0.076	9	0.092	9	0.0629	9
21	Smart Health Care	0.155	8	0.555	4	0.136	8	0.0931	9
22	Noninvasive Sensor based Smart Health Care	0.197	8	0.100	8	0.099	9	0.2486	7
23	Brain Research	0.192	8	0.107	8	0.149	8	0.2853	7

24	Human Brain Map	0.657	3	0.434	5	0.481	5	0.7458	2
25	Robot Technology	0.091	9	0.101	8	0.306	6	0.0817	9
26	Social Common Sense Robot Possible to Communication with Human	0.118	8	0.386	6	0.539	4	0.1711	8
27	3D Print	0.810	1	0.351	6	0.338	6	1.0000	0
28	Producing Artificial Organ 3D Print	0.745	2	0.936	0	0.938	0	1.0000	0
29	Smart Producing System	0.577	4	1.000	0	0.293	7	0.5229	4
30	Self-driving Car based UX2 Communication	0.117	8	0.152	8	0.265	7	0.1591	8
31	Smart Car	0.074	9	1.000	0	0.113	8	0.3594	6
32	Nano Fusion	0.124	8	1.000	0	0.186	8	0.1384	8
33	Smart City	0.031	9	0.164	8	0.078	9	0.0248	9
34	Safety and Intellectualization of City	0.035	9	0.122	8	0.140	8	0.0992	9
		0.022	6.971	0.036	6.147	0.044	6.559	0.0225	6.647

4.3 ETRI Meta Trend

This chapter is that we extracted two groups' gap about all of the future technology that is suggested in ETRI and all of the items that is 34. The size of item is a step distance and a factor that is affect weight value. And we can know two groups of realization about future technology trend of ETRI or big gap of item when comparing two of groups' point of view as all trend of future technology.

Table 20 and Table 21 show that the $SDGM_i$ of two groups about all future technology of ETRI, and the result about interval value, and $PGSW_i, and\ EGSW_i$ between two groups.

We extracted gaps in each items about $PGSW_i, EGSW_i$ of trend that is calculated in Table 20, in Fig. 10. The items are too many, but we can know the gap exists in each items between two groups. And we made coordinate of vector space that was influenced by the gap in each items, about $PGSW_i$, and $EGSW_i$ such as Fig. 11. In the gap of value $PGSW_i$ and $EGSW_i$ is big case, it shows that item 33's gap is big, because the distance gap is also big as we can know in Fig. 12 when it express as circle graph.

Table 21. Gap Tracking in Each items/years of ETRI Meta Trend

No.	ETRI Meta Trend	2011		2012		2013		TREND		YPSGM	YESGM	$APSGM_i$	$AEGM_i$	PIV	EIV
		$PGSW_i$	$EGSW_i$	$PGSW_i$	$EGSW_i$	$PGSW_i$	$EGSW_i$	$PGSW_i$	$EGSW_i$						
1	5 Generation Mobile Communication	2.2941	25.5193	2.2774	5.0690	0.7001	0.6757	3.9208	16.6729	1.5774	20.917	0.3880	0.0456	6	9
2	Network Connection	4.0733	3.2840	0.9655	1.0311	3.6458	4.2088	1.2188	1.2278	4.1039	3.8953	0.1959	0.2043	8	7
3	Mobilization Acceleration	9.9742	3.4941	5.4145	3.3807	12.1762	6.0125	14.0262	4.9202	8.1554	2.6343	0.1092	0.2752	8	7
4	Cyber Security	3.4557	9.8588	0.9534	2.1136	3.6600	7.4322	1.5705	7.6059	3.6861	9.3956	0.2134	0.0962	7	9
5	Global Cyber Attack and Personal Information Collection Respond	0.0000	0.0000	11.805	5.9375	1.2640	2.7941	6.5240	3.6315	15.826	6.7183	0.0594	0.1296	9	8
6	Big Data	3.2434	5.2840	0.8945	1.0561	1.5952	1.7329	3.1109	4.9144	2.4512	4.2817	0.2898	0.1893	7	8
7	Cloud	3.3495	5.9445	8.7986	3.2830	2.9345	4.0540	1.0173	0.8833	8.0050	2.7710	0.1110	0.2652	8	7
8	Real-Time Video Big Data Analysis	1.3364	5.1672	2.4718	0.9040	0.0000	0.0000	0.0000	0.0000	2.7201	4.3580	0.2688	0.1866	7	8
9	Social Research and Climate Change Modeling for Predicting Social, Economy, Environment	1.7108	0.9049	1.9945	2.2389	0.9010	2.0222	1.6850	1.9220	1.1297	1.3516	0.4695	0.4252	5	5
10	Self-Organizing Information Share Platform	4.8557	6.7647	1.7456	1.9708	2.3928	2.7001	6.4965	9.3713	3.1767	4.8491	0.2394	0.1710	7	8
11	Social Network	2.1538	2.6420	1.7713	0.2059	12.7235	1.7240	2.0117	1.1091	10.9589	2.8704	0.0836	0.2584	9	7
12	Hologram Production and Play System	1.6805	2.8185	0.8945	0.7748	0.0000	0.0000	0.5908	0.7413	1.1908	2.1856	0.4565	0.3139	5	6
13	Person-Centered UX/UI	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	0	0
14	Pass Over Five Sense Social UX/UI	5.7471	8.0294	4.1157	5.3655	4.3955	5.6271	6.5488	9.7532	1.6552	2.6767	0.3766	0.2720	6	7
15	Wearable Communication Device	7.5824	1.9118	9.0407	4.2272	5.7255	2.0061	14.3699	2.7411	3.6218	3.2085	0.2164	0.2376	7	7
16	Context-aware X-Computing	24.1471	6.4853	6.1417	4.7076	4.1139	3.4657	17.4146	9.3727	18.119	2.1685	0.0523	0.3156	9	6
17	Next Generation Computing	7.4443	12.6555	6.0731	27.6917	1.2197	1.3513	8.6731	20.7338	5.0434	30.330	0.1655	0.0319	8	9
18	Energy Supply and Next Generation Battery	2.3412	2.6959	2.2127	2.7618	7.4984	19.353	4.5459	6.2929	5.2873	16.591	0.1591	0.0568	8	9
19	Environment and Disaster Respond	1.3595	1.4711	2.9205	4.1427	7.3052	15.759	3.7385	5.2895	4.6543	11.920	0.1769	0.0774	8	9
20	Micro/Metro Energy Gird	3.7395	4.7059	5.0274	11.0993	4.3589	8.8846	7.0332	13.1301	1.4511	6.7661	0.4080	0.1288	5	8
21	Smart Health Care	4.2251	3.4224	0.2657	0.7573	4.9078	4.0085	8.1281	5.3613	6.1013	4.2040	0.1408	0.1922	8	8
22	Noninvasive Sensor based Smart Health Care	2.6966	3.0441	7.2170	5.3625	7.5539	4.9996	2.2443	2.0255	4.5329	2.3466	0.1807	0.2988	8	7
23	Brain Research	3.9854	1.3235	3.4859	7.5950	4.6876	3.2296	1.4822	2.0191	1.3013	7.6412	0.4345	0.1157	5	8
24	Human Brain Map	0.4308	0.2941	1.1399	0.6345	0.9660	0.4842	0.3073	0.1476	0.7301	0.3721	0.5780	0.7288	4	2
25	Robot Technology	9.5166	3.0728	8.7766	1.4199	1.8263	1.3481	11.0725	1.9481	6.9896	1.6544	0.1252	0.3767	8	6
26	Social Common Sense Robot Possible to Communication with Human	4.0695	6.2353	0.6389	1.4536	0.4505	0.7287	2.0577	4.3865	3.4357	4.8363	0.2254	0.1713	7	8
27	3D Print	0.1827	0.1471	1.2341	1.3809	1.9103	0.4174	0.0000	0.0000	1.2501	1.5655	0.4444	0.3898	5	6
28	Producing Artificial Organ 3D Print	0.1765	0.2941	0.0294	0.0617	0.0294	0.0596	0.0000	0.0000	0.1471	0.2324	0.8718	0.8114	1	1
29	Smart Producing System	0.5087	0.5294	0.0000	0.0000	1.8295	1.5681	0.6601	0.6301	1.8989	1.6551	0.3450	0.3766	6	6
30	Self-driving Car based UX2 Communication	1.2353	7.4118	1.4056	5.3934	1.0511	2.5707	0.7926	5.2272	0.3933	3.4701	0.7177	0.2237	2	7
31	Smart Car	11.2331	5.3255	0.0000	0.0000	7.3180	2.9147	1.3476	1.1662	13.407	6.0710	0.0694	0.1414	9	8
32	Nano Fusion	2.1922	6.7345	0.0000	0.0000	1.9320	3.9399	3.3304	5.2580	2.9220	7.8024	0.2550	0.1136	7	8
33	Smart City	29.7737	7.8885	4.6910	1.9878	9.7424	6.6634	38.7729	6.9518	25.586	7.5285	0.0376	0.1173	9	8
34	Safety and Intellectualization of City	26.5725	6.7941	5.6737	4.4449	4.7508	3.8575	14.6920	7.9283	20.919	2.4215	0.0456	0.2923	9	7
										48.843	43.926	0.0201	0.0223	5	5

Table 22. Gap Each Intensity Frequency of ETRI Meta trend

IV	2011	2012	2013	SUM	RATE
GI - 0	2	5	4	11	0.11
GI - 1	1	0	0	1	0.01
GI - 2	1	0	0	1	0.01
GI - 3	1	0	0	1	0.01
GI - 4	1	1	2	4	0.04
GI - 5	0	4	1	5	0.05
GI - 6	2	4	4	10	0.10
GI - 7	3	4	5	12	0.12
GI - 8	13	11	11	35	0.34
GI - 9	10	5	7	22	0.22
	34	34	34	102	1

IV	PIV	EIV	PIV RATE	EIV RATE
GI - 0	1	1	0.03	0.03
GI - 1	1	1	0.03	0.03
GI - 2	1	1	0.03	0.03
GI - 3	0	0	0.00	0.00
GI - 4	1	0	0.03	0.00
GI - 5	5	1	0.15	0.03
GI - 6	3	5	0.09	0.15
GI - 7	7	9	0.21	0.26
GI - 8	9	11	0.26	0.32
GI - 9	6	5	0.18	0.15
	34	34	1	1

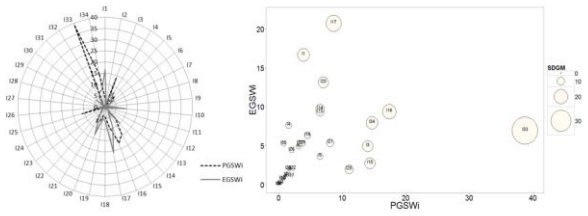

Fig. 10. Each Items $\boldsymbol{PGSW_i, EGSW_i}$ of ETRI Meta Trend Field and Vector Space Coordinate

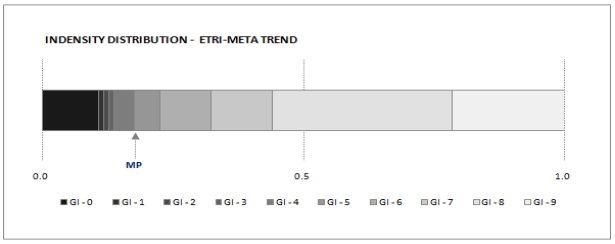

Fig. 11. Gap Intensity Histogram of ETRI Meta Trend

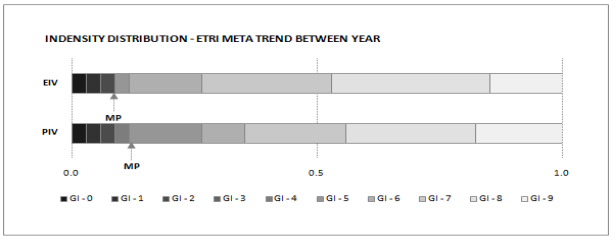

Fig. 12. Gap Intensity Histogram between Public group and Expert Group in Each Year of ETRI Meta Trend

ETRI Meta trend showed that the median value would be moved to the left side from central value. Thus, we can interpret that the gap exists, and the expert group's gap is bigger.

Table 23. ETRI ICT Field Data Adjustment, $SDGM_i, ISGM_i, and\ IV_i$ – Trend

No	ETRI Meta Trend	Sector	PGP	EGP	PGR	EGR	SD_i	PGW_i	EGW_i	$PGSW_i$	$EGSW_i$	$SDGM_i$	$ISGM_i$	GI_i
1	5 Generation Mobile Communication	ICT	0.0414	0.2204	29	11	18	0.1765	0.7059	3.9208	16.6729	17.1277	0.055	9
2	Network Connection	ICT	0.3659	0.3455	6	5	1	0.8529	0.8824	1.2188	1.2278	1.7301	0.366	6
3	Mobilization Acceleration	ICT	0.1708	0.0722	11	27	16	0.7059	0.2353	14.0262	4.9202	14.8641	0.063	9
4	Cyber Security	ICT	0.0326	0.1145	32	19	13	0.0882	0.4706	1.5705	7.6059	7.7663	0.114	8
5	Global Cyber Attack and Personal Information Collection Respond	XT	0.1367	0.0800	15	24	9	0.5882	0.3235	6.5240	3.6315	7.4666	0.118	8
6	Big Data	ICT	0.0915	0.1432	23	16	7	0.3529	0.5588	3.1109	4.9144	5.8163	0.147	8
7	Cloud	ICT	0.0969	0.0887	21	23	2	0.4118	0.3529	1.0173	0.8833	1.3473	0.426	5
8	Real-Time Video Big Data Analysis	ICT	0.0365	0.0451	30	30	0	0.1471	0.1471	0.0000	0.0000	0.0000	1.000	0
9	Social Research and Climate Change Modeling for Predicting Social, Economy, Environment	ICT-Con.	0.1660	0.2257	12	10	2	0.6765	0.7353	1.6850	1.9220	2.5560	0.281	7
10	Self-Organizing Information Share Platform	ICT-Con.	0.2886	0.5913	8	2	6	0.7941	0.9706	6.4965	9.3713	11.4029	0.081	9
11	Social Network	ICT	0.0788	0.0454	24	29	5	0.3235	0.1765	2.0117	1.1091	2.2972	0.303	6
12	Hologram Production and Play System	ICT	0.0601	0.0766	27	25	2	0.2353	0.2941	0.5908	0.7413	0.9479	0.513	4
13	Person-Centered UX/UI	ICT	1.1789	0.8226	1	1	0	1.0000	1.0000	0.0000	0.0000	0.0000	1.000	0
14	Pass Over Five Sense Social UX/UI	ICT-Con.	0.2003	0.4521	10	3	7	0.7353	0.9412	6.5488	9.7532	11.7478	0.078	9
15	Wearable Communication Device	ICT	0.1513	0.0346	13	31	18	0.6471	0.1176	14.3699	2.7411	14.6290	0.064	9
16	Context-aware X-Computing	ICT-Con.	0.6126	0.2050	2	13	11	0.9706	0.6471	17.4146	9.3727	19.7766	0.048	9
17	Next Generation Computing	ICT	0.1009	0.3841	20	4	16	0.4412	0.9118	8.6731	20.7338	22.4748	0.043	9
18	Energy Supply and Next Generation Battery	XT	0.1400	0.2547	14	8	6	0.6176	0.7941	4.5459	6.2929	7.7631	0.114	8
19	Environment and Disaster Respond	XT	0.1231	0.2051	18	12	6	0.5000	0.6765	3.7385	5.2895	6.4772	0.134	8
20	Micro/Metro Energy Gird	ICT-Con.	0.1155	0.2706	19	7	12	0.4706	0.8235	7.0332	13.1301	14.8951	0.063	9
21	Smart Health Care	XT	0.2513	0.1407	9	17	8	0.7647	0.5294	8.1281	5.3613	9.7370	0.093	9
22	Noninvasive Sensor based Smart Health Care	ICT-Con.	0.2986	0.2480	7	9	2	0.8235	0.7647	2.2443	2.0255	3.0232	0.249	7
23	Brain Research	XT	0.0764	0.0930	25	21	4	0.2941	0.4118	1.4822	2.0191	2.5047	0.285	7
24	Human Brain Map	ICT-Con.	0.0360	0.0150	31	33	2	0.1176	0.0588	0.3073	0.1476	0.3409	0.746	2
25	Robot Technology	XT	0.1332	0.0335	16	32	16	0.5588	0.0882	11.0725	1.9481	11.2426	0.082	9
26	Social Common Sense Robot Possible to Communication with Human	ICT-Con.	0.0513	0.1071	28	20	8	0.2059	0.4412	2.0577	4.3865	4.8452	0.171	8
27	3D Print	XT	0.0726	0.0736	26	26	0	0.2647	0.2647	0.0000	0.0000	0.0000	1.000	0
28	Producing Artificial Organ 3D Print	ICT-Con.	0.0000	0.0037	34	34	0	0.0294	0.0294	0.0000	0.0000	0.0000	1.000	0
29	Smart Producing System	ICT-Con.	0.1306	0.1301	17	18	1	0.5294	0.5000	0.6601	0.6301	0.9126	0.523	4
30	Self-driving Car based UX2 Communication	ICT-Con.	0.0132	0.0928	33	22	11	0.0588	0.3824	0.7926	5.2272	5.2869	0.159	8
31	Smart Car	XT	0.4653	0.3133	5	6	1	0.8824	0.8529	1.3476	1.1662	1.7822	0.359	6
32	Nano Fusion	XT	0.0934	0.1629	22	15	7	0.3824	0.5882	3.3304	5.2580	6.2240	0.138	8
33	Smart City	XT	0.6097	0.0722	3	28	25	0.9412	0.2059	38.7729	6.9518	39.3911	0.025	9
34	Safety and Intellectualization of City	ICT-Con.	0.5574	0.1752	4	14	10	0.9118	0.6176	14.6920	7.9283	16.6947	0.057	9
							7.41					43.3527	0.023	6.65

Table 24. ETRI ICT Field Data Adjustment, $SDGM_i, ISGM_i, and\ IV_i$ - 2011

No	ETRI Meta Trend	Sector	PGP	EGP	PGR	EGR	SD_i	PGW_i	EGW_i	$PGSW_i$	$EGSW_i$	$SDGM_i$	$ISGM_i$	GI_i
1	5 Generation Mobile Communication	ICT	0.0000	0.1286	32	6	26	0.0882	0.8529	2.2941	25.5193	25.6222	0.038	9
2	Network Connection	ICT	0.1654	0.0857	6	10	4	0.8529	0.7353	4.0733	3.2840	5.2323	0.160	8
3	Mobilization Acceleration	ICT	0.0654	0.0143	13	27	14	0.6471	0.2353	9.9742	3.4941	10.5685	0.086	9
4	Cyber Security	ICT	0.0115	0.0571	27	13	14	0.2353	0.6471	3.4557	9.8588	10.4469	0.087	9
5	Global Cyber Attack and Personal Information Collection Respond	XT	0.0186	0.0182	24	24	0	0.3235	0.3235	0.0000	0.0000	0.0000	1.000	0
6	Big Data	ICT	0.0231	0.0429	22	14	8	0.3824	0.6176	3.2434	5.2840	6.2001	0.139	8
7	Cloud	ICT	0.0192	0.0429	23	14	9	0.3529	0.6176	3.3495	5.9445	6.8233	0.128	8
8	Real-Time Video Big Data Analysis	ICT	0.0038	0.0286	31	20	11	0.1176	0.4412	1.3364	5.1672	5.3373	0.158	8
9	Social Research and Climate Change Modeling for Predicting Social, Economy, Environment	ICT-Con.	0.0186	0.0045	24	29	5	0.3235	0.1765	1.7108	0.9049	1.9354	0.341	6
10	Self-Organizing Information Share Platform	ICT-Con.	0.1476	0.3824	7	2	5	0.8235	0.9706	4.8557	6.7647	8.3270	0.107	8
11	Social Network	ICT	0.0385	0.0429	18	14	4	0.5000	0.6176	2.1538	2.6420	3.4087	0.227	7
12	Hologram Production and Play System	ICT	0.0154	0.0286	26	20	6	0.2647	0.4412	1.6805	2.8185	3.2815	0.234	7
13	Person-Centered UX/UI	ICT	0.5423	0.3857	1	1	0	1.0000	1.0000	0.0000	0.0000	0.0000	1.000	0
14	Pass Over Five Sense Social UX/UI	ICT-Con.	0.0857	0.2059	10	3	7	0.7353	0.9412	5.7471	8.0294	9.8742	0.092	9
15	Wearable Communication Device	ICT	0.0538	0.0000	17	30	13	0.5294	0.1471	7.5824	1.9118	7.8196	0.113	8
16	Context-aware X-Computing	ICT-Con.	0.2381	0.0147	4	25	21	0.9118	0.2941	24.1471	6.4853	25.0028	0.038	9
17	Next Generation Computing	ICT	0.0615	0.1429	16	4	12	0.5588	0.9118	7.4443	12.6555	14.6826	0.064	9
18	Energy Supply and Next Generation Battery	XT	0.0745	0.1045	11	8	3	0.7059	0.7941	2.3412	2.6959	3.5706	0.219	7
19	Environment and Disaster Respond	XT	0.0621	0.0591	14	12	2	0.6176	0.6765	1.3595	1.4711	2.0031	0.333	6
20	Micro/Metro Energy Gird	ICT-Con.	0.0714	0.1176	12	7	5	0.6765	0.8235	3.7395	4.7059	6.0108	0.143	8
21	Smart Health Care	XT	0.1739	0.0909	5	9	4	0.8824	0.7647	4.2251	3.4224	5.4373	0.155	8
22	Noninvasive Sensor based Smart Health Care	ICT-Con.	0.1048	0.1324	8	5	3	0.7941	0.8824	2.6966	3.0441	4.0668	0.197	8
23	Brain Research	XT	0.0311	0.0000	21	30	9	0.4118	0.1471	3.9854	1.3235	4.1994	0.192	8
24	Human Brain Map	ICT-Con.	0.0095	0.0000	28	30	2	0.2059	0.1471	0.4308	0.2941	0.5216	0.657	3
25	Robot Technology	XT	0.0621	0.0136	14	28	14	0.6176	0.2059	9.5166	3.0728	10.0004	0.091	9
26	Social Common Sense Robot Possible to Communication with Human	ICT-Con.	0.0381	0.0735	19	11	8	0.4706	0.7059	4.0695	6.2353	7.4458	0.118	8
27	3D Print	XT	0.0062	0.0000	29	30	1	0.1765	0.1471	0.1827	0.1471	0.2345	0.810	1
28	Producing Artificial Organ 3D Print	ICT-Con.	0.0000	0.0000	32	30	2	0.0882	0.1471	0.1765	0.2941	0.3430	0.745	2
29	Smart Producing System	ICT-Con.	0.0381	0.0294	19	18	1	0.4706	0.5000	0.5087	0.5294	0.7342	0.577	4
30	Self-driving Car based UX2 Communication	ICT-Con.	0.0000	0.0294	32	18	14	0.0882	0.5000	1.2353	7.4118	7.5140	0.117	8
31	Smart Car	XT	0.0994	0.0273	9	22	13	0.7647	0.3824	11.2331	5.3255	12.4315	0.074	9
32	Nano Fusion	XT	0.0062	0.0318	29	17	12	0.1765	0.5294	2.1922	6.7345	7.0824	0.124	8
33	Smart City	XT	0.4472	0.0227	2	23	21	0.9706	0.3529	29.7737	7.8885	30.8010	0.031	9
	Safety and Intellectualization of City	ICT-Con.	0.2667	0.0147	3	25	22	0.9412	0.2941	26.5725	6.7941	27.4274	0.035	9
							8.68					45.2757	0.022	6.97

Table 25. ETRI ICT Field Data Adjustment, $SDGM_i, ISGM_i, and\ IV_i$ - 2012

No	ETRI Meta Trend	Sector	PGP	EGP	PGR	EGR	SD_i	PGW_i	EGW_i	$PGSW_i$	$EGSW_i$	$SDGM_i$	$ISGM_i$	GI_i
1	5 Generation Mobile Communication	ICT	0.0178	0.0632	27	18	9	0.2353	0.5000	2.2774	5.0690	5.5571	0.153	8
2	Network Connection	ICT	0.1420	0.1782	7	6	1	0.8235	0.8529	0.9655	1.0311	1.4126	0.414	5
3	Mobilization Acceleration	ICT	0.0592	0.0402	14	22	8	0.6176	0.3824	5.4145	3.3807	6.3833	0.135	8
4	Cyber Security	ICT	0.0118	0.0287	30	24	6	0.1471	0.3235	0.9534	2.1136	2.3187	0.301	6
5	Global Cyber Attack and Personal Information Collection Respond	XT	0.1139	0.0450	8	21	13	0.7941	0.4118	11.8045	5.9375	13.214	0.070	9
6	Big Data	ICT	0.0355	0.0575	21	19	2	0.4118	0.4706	0.8945	1.0561	1.3840	0.419	5
7	Cloud	ICT	0.0592	0.0172	14	27	13	0.6176	0.2353	8.7986	3.2830	9.3912	0.096	9
8	Real-Time Video Big Data Analysis	ICT	0.0296	0.0115	24	31	7	0.3235	0.1176	2.4718	0.9040	2.6319	0.275	7
9	Social Research and Climate Change Modeling for Predicting Social, Economy, Environment	ICT-Con.	0.1443	0.2077	6	4	2	0.8529	0.9118	1.9945	2.2389	2.9985	0.250	7
10	Self-Organizing Information Share Platform	ICT-Con.	0.1081	0.1618	9	7	2	0.7647	0.8235	1.7456	1.9708	2.6327	0.275	7
11	Social Network	ICT	0.0178	0.0000	27	34	7	0.2353	0.0294	1.7713	0.2059	1.7832	0.359	6
12	Hologram Production and Play System	ICT	0.0355	0.0345	21	23	2	0.4118	0.3529	0.8945	0.7748	1.1835	0.458	5
13	Person-Centered UX/UI	ICT	0.4970	0.3276	1	1	0	1.0000	1.0000	0.0000	0.0000	0.0000	1.000	0
14	Pass Over Five Sense Social UX/UI	ICT-Con.	0.0878	0.1908	10	5	5	0.7353	0.8824	4.1157	5.3655	6.7622	0.129	8
15	Wearable Communication Device	ICT	0.0769	0.0287	12	24	12	0.6765	0.3235	9.0407	4.2272	9.9802	0.091	9
16	Context-aware X-Computing	ICT-Con.	0.2872	0.1474	3	8	5	0.9412	0.7941	6.1417	4.7076	7.7383	0.114	8
17	Next Generation Computing	ICT	0.0178	0.2126	27	3	24	0.2353	0.9412	6.0731	27.698	28.350	0.034	9
18	Energy Supply and Next Generation Battery	XT	0.0532	0.0728	18	14	4	0.5000	0.6176	2.2127	2.7618	3.5388	0.220	7
19	Environment and Disaster Respond	XT	0.0456	0.0728	20	14	6	0.4412	0.6176	2.9205	4.1427	5.0687	0.165	8
20	Micro/Metro Energy Gird	ICT-Con.	0.0338	0.1185	23	10	13	0.3529	0.7353	5.0274	11.0993	12.1848	0.076	9
21	Smart Health Care	XT	0.0076	0.0128	33	29	4	0.0588	0.1765	0.2657	0.7573	0.8025	0.555	4
22	Noninvasive Sensor based Smart Health Care	ICT-Con.	0.1486	0.0896	5	12	7	0.8824	0.6765	7.2170	5.3625	8.9912	0.100	8

23	Brain Research	XT	0.0228	0.0728	25	14	11	0.2941	0.6176	3.4859	7.5950	8.3568	0.107	8
24	Human Brain Map	ICT-Con.	0.0203	0.0116	26	30	4	0.2647	0.1471	1.1399	0.6345	1.3046	0.434	5
25	Robot Technology	XT	0.0557	0.0064	17	32	15	0.5294	0.0882	8.7766	1.4199	8.8907	0.101	8
26	Social Common Sense Robot Possible to Communication with Human	ICT-Con.	0.0101	0.0260	31	26	5	0.1176	0.2647	0.6389	1.4536	1.5878	0.386	6
27	3D Print	XT	0.0582	0.0728	16	14	2	0.5588	0.6176	1.2341	1.3809	1.8520	0.351	6
28	Producing Artificial Organ 3D Print	ICT-Con.	0.0000	0.0029	34	33	1	0.0294	0.0588	0.0294	0.0617	0.0684	0.936	0
29	Smart Producing System	ICT-Con.	0.0709	0.0780	13	13	0	0.6471	0.6471	0.0000	0.0000	0.0000	1.000	0
30	Self-driving Car based UX2 Communication	ICT-Con.	0.0101	0.0491	31	20	11	0.1176	0.4412	1.4056	5.3934	5.5736	0.152	8
31	Smart Car	XT	0.3443	0.2784	2	2	0	0.9706	0.9706	0.0000	0.0000	0.0000	1.000	0
32	Nano Fusion	XT	0.0810	0.1092	11	11	0	0.7059	0.7059	0.0000	0.0000	0.0000	1.000	0
33	Smart City	XT	0.0506	0.0150	19	28	9	0.4706	0.2059	4.6910	1.9878	5.0948	0.164	8
34	Safety and Intellectualization of City	ICT-Con.	0.2230	0.1243	4	9	5	0.9118	0.7647	5.6737	4.4449	7.2075	0.122	8
							6.3235					26.765	0.036	6.15

Table 26. ETRI ICT Field Data Adjustment, $SDGM_i, ISGM_i, and\ IV_i$ - 2013

No	ETRI Meta Trend	Sector	PGP	EGP	PGR	EGR	SD_i	PGW_i	EGW_i	$PGSW_i$	$EGSW_i$	$SDGM_i$	$ISGM_i$	GI_i
1	5 Generation Mobile Communication	ICT	0.0236	0.0286	12	13	1	0.6765	0.6471	0.7001	0.6757	0.9729	0.507	4
2	Network Connection	ICT	0.0585	0.0816	6	2	4	0.8529	0.9706	3.6458	4.2088	5.5682	0.152	8
3	Mobilization Acceleration	ICT	0.0462	0.0177	7	21	14	0.8235	0.4118	12.1762	6.0125	13.5798	0.069	9
4	Cyber Security	ICT	0.0092	0.0286	24	13	11	0.3235	0.6471	3.6600	7.4322	8.2846	0.108	8
5	Global Cyber Attack and Personal Information Collection Respond	XT	0.0041	0.0168	29	22	7	0.1765	0.3824	1.2640	2.7941	3.0667	0.246	7
6	Big Data	ICT	0.0329	0.0429	9	7	2	0.7647	0.8235	1.5952	1.7329	2.3553	0.298	7
7	Cloud	ICT	0.0185	0.0286	19	13	6	0.4706	0.6471	2.9345	4.0540	5.0046	0.167	8
8	Real-Time Video Big Data Analysis	ICT	0.0031	0.0050	30	30	0	0.1471	0.1471	0.0000	0.0000	0.0000	1.000	0
9	Social Research and Climate Change Modeling for Predicting Social, Economy, Environment	ICT-Con.	0.0031	0.0135	30	24	6	0.1471	0.3235	0.9010	2.0222	2.2138	0.311	6
10	Self-Organizing Information Share Platform	ICT-Con.	0.0329	0.0471	9	6	3	0.7647	0.8529	2.3928	2.7001	3.6078	0.217	7
11	Social Network	ICT	0.0226	0.0025	13	32	19	0.6471	0.0882	12.7235	1.7240	12.8398	0.072	9
12	Hologram Production and Play System	ICT	0.0092	0.0135	24	24	0	0.3235	0.3235	0.0000	0.0000	0.0000	1.000	0
13	Person-Centered UX/UI	ICT	0.1396	0.1093	1	1	0	1.0000	1.0000	0.0000	0.0000	0.0000	1.000	0
14	Pass Over Five Sense Social UX/UI	ICT-Con.	0.0267	0.0555	11	5	6	0.7059	0.8824	4.3955	5.6271	7.1404	0.123	8
15	Wearable Communication Device	ICT	0.0205	0.0059	18	29	11	0.5000	0.1765	5.7255	2.0061	6.0668	0.142	8
16	Context-aware X-Computing	ICT-Con.	0.0873	0.0429	3	7	4	0.9412	0.8235	4.1139	3.4657	5.3792	0.157	8
17	Next Generation Computing	ICT	0.0216	0.0286	15	13	2	0.5882	0.6471	1.2197	1.3513	1.8203	0.355	6
18	Energy Supply and Next Generation Battery	XT	0.0123	0.0774	22	3	19	0.3824	0.9412	7.4984	19.3530	20.7548	0.046	9
19	Environment and Disaster Respond	XT	0.0154	0.0732	20	4	16	0.4412	0.9118	7.3052	15.7594	17.3703	0.054	9
20	Micro/Metro Energy Gird	ICT-Con.	0.0103	0.0345	23	11	12	0.3529	0.7059	4.3589	8.8846	9.8963	0.092	9
21	Smart Health Care	XT	0.0698	0.0370	4	9	5	0.9118	0.7647	4.9078	4.0085	6.3368	0.136	8
22	Noninvasive Sensor based Smart Health Care	ICT-Con.	0.0452	0.0261	8	17	9	0.7941	0.5294	7.5539	4.9996	9.0585	0.099	9
23	Brain Research	XT	0.0226	0.0202	13	20	7	0.6471	0.4412	4.6876	3.2296	5.6925	0.149	8
24	Human Brain Map	ICT-Con.	0.0062	0.0034	27	31	4	0.2353	0.1176	0.9660	0.4842	1.0805	0.481	5
25	Robot Technology	XT	0.0154	0.0135	20	24	4	0.4412	0.3235	1.8263	1.3481	2.2700	0.306	6
26	Social Common Sense Robot Possible to Communication with Human	ICT-Con.	0.0031	0.0076	30	27	3	0.1471	0.2353	0.4505	0.7287	0.8567	0.539	4
27	3D Print	XT	0.0082	0.0008	26	33	7	0.2647	0.0588	1.9103	0.4174	1.9554	0.338	6
28	Producing Artificial Organ 3D Print	ICT-Con.	0.0000	0.0008	34	33	1	0.0294	0.0588	0.0294	0.0596	0.0665	0.938	0
29	Smart Producing System	ICT-Con.	0.0216	0.0227	15	18	3	0.5882	0.5000	1.8295	1.5681	2.4096	0.293	7
30	Self-driving Car based UX2 Communication	ICT-Con.	0.0031	0.0143	30	23	7	0.1471	0.3529	1.0511	2.5707	2.7773	0.265	7
31	Smart Car	XT	0.0216	0.0076	15	27	12	0.5882	0.2353	7.3180	2.9147	7.8771	0.113	8
32	Nano Fusion	XT	0.0062	0.0219	27	19	8	0.2353	0.4706	1.9320	3.9399	4.3881	0.186	8
33	Smart City	XT	0.1119	0.0345	2	11	9	0.9706	0.7059	9.7424	6.6634	11.8032	0.078	9
34	Safety and Intellectualization of City	ICT-Con.	0.0678	0.0362	5	10	5	0.8824	0.7353	4.7508	3.8575	6.1196	0.140	8
							6.6765					21.7961	0.044	6.56

5. COMPARE BETWEEN INSTITUTIONS USING $SDGM_i$ MODEL

This chapter shows that this model can analyze the gap between the public group and expert group adapting to future technologies meta-system of the various institution using $SDGM_i$ model. KEIT is an institution that announces the future technologies demanded according to future issue. After analyzing gap of two groups about future technologies that are announced by KEIT, we can compare the degree of the gap about future technologies in each institution. Expanding this, we can know what institutions announce future technologies that are near to the needs of public people.

This chapter analyzed gap of two groups with future issues announced in KEIT following criteria grouping through the $?\mathcal{X} \rightarrow \text{associatedCategory} \rightarrow ?\text{y}$ inference, and compared the result to each institution, analyzing the gap between two groups to future technologies of ETRI as same criteria.

Table 27. KEIT Future Issue Data Adjustment, $SDGM_i, ISGM_i, and\ IV_i$ - Trend

No	KEIT Future Issue	EC	PC	PGP	EGP	PGR	EGR	SD_i	PGW_i	EGW_i	$PGSW_i$	$EGSW_i$	SDGM	$ISGM_i$	PGIV
1	Imaginary Intelligence Space and Secure Voucher through Connection	12	4	0.0186	0.0059	14	22	8	0.6667	0.4615	5.4819	3.7399	6.6361	0.131	8
2	Generalization Convenient Technology based on Sensitivity	26	32	0.0402	0.0475	9	9	0	0.7949	0.7949	0.0000	0.0000	0.0000	1.000	0
3	Expand Personalized Service	2	35	0.0031	0.0520	27	7	20	0.3333	0.8462	6.7286	17.9632	19.1820	0.050	9
4	Develop of Personal Portable Appliance	12	28	0.0186	0.0416	14	10	4	0.6667	0.7692	2.7410	3.2433	4.2464	0.191	8
5	Change Population Structure	0	1	0.0000	0.0015	35	30	5	0.1282	0.2564	0.6410	1.2895	1.4400	0.410	5
6	Diversification of Science Technology Influence	49	27	0.0759	0.0401	4	11	7	0.9231	0.7436	6.9925	5.4860	8.8877	0.101	8
7	Accelerate Science Technology Fusion	7	3	0.0108	0.0045	19	25	6	0.5385	0.3846	3.2958	2.3344	4.0388	0.198	8
8	Side Effect according to Developing Technology	0	3	0.0000	0.0045	35	25	10	0.1282	0.3846	1.2821	3.8907	4.0965	0.196	8
9	New Martial Fusion by Nano Technology	3	10	0.0046	0.0149	24	16	8	0.4103	0.6154	3.3192	5.0419	6.0364	0.142	8
10	Appearance Social Network Politic	0	1	0.0000	0.0015	35	30	5	0.1282	0.2564	0.6410	1.2895	1.4400	0.410	5
11	Develop Alternative Energy	1	1	0.0015	0.0015	30	30	0	0.2564	0.2564	0.0000	0.0000	0.0000	1.000	0
12	Change of Enjoyment Pattern and Culture Consumption	7	26	0.0108	0.0386	19	12	7	0.5385	0.7179	3.8451	5.2961	6.5447	0.133	8
13	Development of Future Network Service Industry	122	43	0.1889	0.0639	1	5	4	1.0000	0.8974	4.7554	3.8453	6.1156	0.141	8
14	Create Future Infrastructure	12	43	0.0186	0.0639	14	5	9	0.6667	0.8974	6.1672	8.6520	10.6250	0.086	9
15	Future IT Convergence Evolution	64	58	0.0991	0.0862	3	3	0	0.9487	0.9487	0.0000	0.0000	0.0000	1.000	0
16	Future Clean Energy System	2	2	0.0031	0.0030	27	27	0	0.3333	0.3333	0.0000	0.0000	0.0000	1.000	0
17	Expand Area of Bio-technology Utilization	28	6	0.0433	0.0089	8	21	13	0.8205	0.4872	11.2301	6.4492	12.9502	0.072	9
18	Appearance of New Health Harm Factor	2	0	0.0031	0.0000	27	36	9	0.3333	0.1026	3.0279	0.9231	3.1654	0.240	7
19	Reinforce Contents based on Social SNS	3	8	0.0046	0.0119	24	18	6	0.4103	0.5641	2.4894	3.4559	4.2592	0.190	8
20	Expand App Mobile Contents based on Demand	8	62	0.0124	0.0921	18	2	16	0.5641	0.9744	9.2238	17.0637	19.3971	0.049	9
21	Expand Smart Green Infrastructure	4	4	0.0062	0.0059	23	22	1	0.4359	0.4615	0.4421	0.4675	0.6434	0.608	3
22	Display Technology Expressing Same Appearance	29	17	0.0449	0.0253	7	13	6	0.8462	0.6923	5.3463	4.3054	6.8643	0.127	8
23	Polarization and Individualization	1	1	0.0015	0.0015	30	30	0	0.2564	0.2564	0.0000	0.0000	0.0000	1.000	0
24	Change of Energy Resource Paradigm	1	1	0.0015	0.0015	30	30	0	0.2564	0.2564	0.0000	0.0000	0.0000	1.000	0
25	Energy Natural Resources Exhaustion and Crisis	1	1	0.0015	0.0015	30	30	0	0.2564	0.2564	0.0000	0.0000	0.0000	1.000	0
26	Important of Leisure and Culture	0	4	0.0000	0.0059	35	22	13	0.1282	0.4615	1.6667	6.0773	6.3017	0.137	8
27	Realization Energy Storage based on Hydrogen Energy	6	0	0.0093	0.0000	21	36	15	0.4872	0.1026	7.4470	1.5385	7.6043	0.116	8
28	Realization Ubiquitous Network Social	26	46	0.0402	0.0684	9	4	5	0.7949	0.9231	4.1756	4.9571	6.4814	0.134	8
29	Lead Technology Revolution of Fusion Technology	9	8	0.0139	0.0119	17	18	1	0.5897	0.5641	0.6037	0.5760	0.8344	0.545	4
30	Automation Technology based on Artificial	20	13	0.0310	0.0193	11	15	4	0.7436	0.6410	3.0982	2.6414	4.0713	0.197	8
31	Expand Technology based on Consumer Sensitivity and Cognitive Science	76	117	0.1176	0.1738	2	1	1	0.9744	1.0000	1.0920	1.1738	1.6032	0.384	6
32	New Evolution of Information and Communications Technology	35	14	0.0542	0.0208	5	14	9	0.8974	0.6667	8.5645	6.1872	10.5657	0.086	9
33	Construct Intelligent High Efficiency Energy System	20	9	0.0310	0.0134	11	17	6	0.7436	0.5897	4.6473	3.6187	5.8900	0.145	8
34	Construct Intelligent New Regeneration Energy System	6	2	0.0093	0.0030	21	27	6	0.4872	0.3333	2.9788	2.0178	3.5979	0.217	7
35	Reinforce Economy based on Knowledge	18	7	0.0279	0.0104	13	20	7	0.6923	0.5128	5.0412	3.6626	6.2312	0.138	8
36	Carbon Emission Reduction Type Green Technology Generalization	3	0	0.0046	0.0000	24	36	12	0.4103	0.1026	4.9788	1.2308	5.1287	0.163	8
37	Realization of Hologram Technology	30	34	0.0464	0.0505	6	8	2	0.8718	0.8205	1.8365	1.7421	2.5313	0.283	7
38	Environmental Pollution Deepen	1	0	0.0015	0.0000	30	36	6	0.2564	0.1026	1.5477	0.6154	1.6656	0.375	6
39	Develop Green Technology Corresponding Environmental Pollution	0	2	0.0000	0.0030	35	27	8	0.1282	0.3333	1.0256	2.6904	2.8793	0.258	7
		646	673	1	1			6.1282	1.0256	1.0256	3.2398	3.4222	18.0447	0.053	

5.1 KEIT Each Future Issue Gap Analysis

KEIT announced future issues and social trends for announcing future technologies and suggested associated future technologies. Due to this character, it is difficult to compare two groups with future technologies that are announced by KEIT directly. Therefore, we analyzed that two groups' documents that are associated with future hopeful technologies, for analyzing gap about future technologies of KEIT.

Table 27 is $PGSW_i, EGSW_i, SDGM_i$, and interval values result to 39 future issues of KEIT. The vector space coordinate of $PGSW_i, EGSW_i$ of KEIT that is calculated in Table 27, is outputted in Fig. 13, and part of items' cases showed that the gap exists.

Table 28. Gap Intensity Frequency of KEIT future Issue

GI	KEIT-ISSUE	Distribution
GI - 0	7	0.18
GI - 1	0	0.00
GI - 2	0	0.00
GI - 3	1	0.03
GI - 4	1	0.03
GI - 5	2	0.05
GI - 6	2	0.05
GI - 7	4	0.10
GI - 8	17	0.44
GI - 9	5	0.13
	39	1

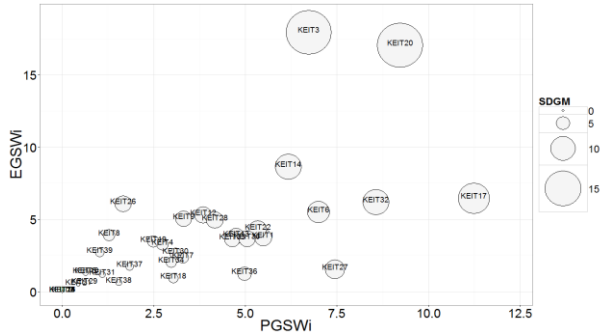

Fig. 13. $\boldsymbol{PGSW_i, EGSW_i}$ Vector Space Coordinate of public group and expert group about KEIT future issue

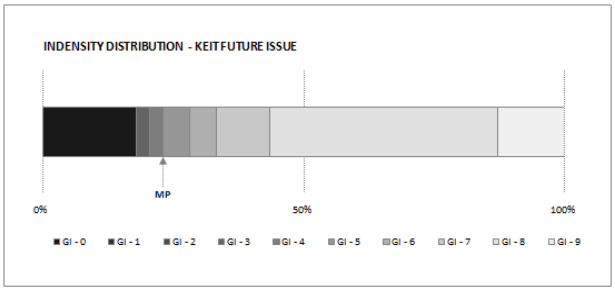

Fig. 14. Gap Intensity Histogram of KEIT Future Issue

In the case of KEIT future issue, the median value is located in left side of central value. Also, we can know the distribution of 0 value that can be said the gap exists, is spread extensively. Thus, the KEIT future issues had the gap existed.

6. CONCLUSION

We suggested SDGM model to analyze the gap between two groups. Through this model, we can express the gap in vector space and histogram. Therefore, this research can be an abstract framework that interprets the gap according to the gap intensity histogram that is based on the gap analysis process between expert people and public people. We analyzed public people idea paper and the future technologies papers that announced ETRI and composed future technologies meta-system ontology. Moreover, we overcame the limitation of machine learning by processing supervised tagging about each paper. Moreover, we fulfilled relation inference among instances of future technology meta-system ontology.

Especially, this is a framework of significant meaning that was suggested to overcome the problem of gap analysis that limited on statistic method using survey and interview. Also, this framework can reflect documents of two groups continuously by constructing future technology meta-system ontology. Moreover, it has an advantage that can predict the change of meta-trend about future technology because of tracking processing about two groups' gap.

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