Change of Government R&D in HCI Categories in Korea

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Abstract. As the convergence between machine/electronics and humanities/biology is increasing, HCI is expected to become a significant trend in terms of both technology and socio-economy in the future. The aim of this paper is to briefly illustrate the growing importance of government R&D in Korea as a high R&D intensity country. The R&D spending scale of HCI was examined from 2009 until 2013. In addition, changes of the research characteristics were analyzed in terms of different indices, such as research and experimental development stages, the type of research-conducting agent, a classification in terms of 6 kinds of technologies (6T), and socio-economic objectives of research. In this study, HCI related categories were carefully selected using the Korean national classification system of science and technology. Through empirical evidence, this study will provide practical implications for future HCI technologies in terms of government R&D strategy.

Keywords: Korea · Government R&D · S&T classification system · R&D spending on HCI

1 Introduction

HCI (Human Computer Interaction) is increasing in importance from a social view as well as a technological view. This is partly due to its representative role in fusion research. Fusion research is a prominent characteristic of advanced science technology. While "humans" and "computers" were seen as very distant from each other, fusion research examines the interactions between these two spheres. In its initial stage fusion research focused mainly on the combination and connection of fairly similar areas. As fusion research became more mature, however, it started to also examine the combinations of and connections between very different areas. As a result, research in HCI areas that were characterized by a high level of qualitative difficulty became more and more active – signifying an increase in the standard of fusion research. From a social point of view, HCI's importance can be explained through its relevance to future trends which are evoked by technological and social change. Among the recent key-trends that impact the future "IoT (Internet of Things)" and "Hyper-connected Society" are the most prominently mentioned. HCI has connected two spheres that were traditionally cut off from each other, humans and machines, and recognized the impact that they have on each other. Thus, it can be said that HCI is a core element of future society.

C. Stephanidis (Ed.): HCII 2015 Posters, Part II, CCIS 529, pp. 192–197, 2015.
DOI: 10.1007/978-3-319-21383-5_33

The importance of fusion research in Korea's national research and development policies is steadily increasing. In 2008, the Korean government introduced "Fundamental plans for the development of national fusion technology ('09–'13)". In 2014, it took another step by creating the "Fusion technology strategy for realizing a creative economy ('14–'18)". Considering that fusion research is a prominent field, Korea's investments in HCI research and development can be expected to have increased after 2009. The "Fundamental plans for the development of national fusion technology ('09–'13)" actually included the strengthening of support fusion technology and humanities/culture/arts etc. as one main strategy. Moreover, it is likely that also the research characteristics have changed in a way that the research and development has sped up and the research contents reflect the needs of society.

2 Approach

In order to examine the change of HCI in Korea's national research and development, research spending scale and characteristics of HCI processes at the starting point of the "Fundamental plans for the development of national fusion technology ('09–'13)" in 2009 were compared to those related to the national research and development undertaking in 2013. Data is annually provided by the Ministry of Science, ICT and Future Planning in their "Governmental R&D survey and analysis" and was also used for the purpose of this study. This data includes the contents and research funds as well as other diverse information about all national research and development processes. While in 2009, the number of research subjects amounted to 39,565, by 2013 it had risen to 50.865. The Korean national standard classification system on science and technology was used to find out which of these subjects were related to HCI. This classification system is organized into 6 fields, 33 categories, 369 divisions and 2,899 sections. Categories that were related to "Humans" and "Computers" were analyzed one by one and those that contained research subjects related to HCI were selected. As can be seen in the table below, 7 categories were found to be related to "Humans", and 2 categories were selected for their relation to "Computers" (Table 1).

Table 1. HCI related categories from the Korean national standard classification system on S&T

	Field	category
Human	H. Humanities	HA. History/Archeology
		HB. Philosophy/Religion
		HC. Linguistics
		HD. Literature
		HE. Culture/Arts/Sports
	O. Human Science and Technologies	OA. Brain Sciences
		OB. Cognitive/Emotion & Sensibility Sciences
Computer	E. Engineering	ED. Electricity and Electronics
		EE. Information/Communication

The importance of HCI and its change in characteristics was analyzed by comparing HCI research from 2013 to the selected subjects from 2009. To assess HCI's importance the scale of research funds was analyzed. Furthermore, the rate of increase of all national research and development undertakings as well as that of HCI related funds were compared. Certain studies also analyzed the degree of research maturity, the performance, the technological field, and the research objective. The table below summarizes the relevant indices and contents (Table 2).

Table 2. List of Indices analyzed

View	Index	Contents
Importance	R&D Spending	Governmental R&D
Technological Maturity	R&D Stage	Basic research/ Applied research / Experimental development
	Technology life cycle	Introduction / Growth / Maturity / Decline
Actor	Type of research-conducting agent	University / Industry / GRI ; Government Related Institute
Technological field	Classification in terms of 6 kinds of technologies (6T)	IT (information) / BT (biology) / NT (nano) / CT (culture) / ET (environment) / ST (space)
Purpose	Socio-economic objective	13 categories in Public sector and 20 categories in industry

3 Results

3.1 Importance in Governmental R&D: R&D Spending

The result of comparing analysis shows that research in HCI categories increased more than 4 times faster than entire government R&D during a five-year period. Especially growth rate of research spending of HCI is 2 times higher than that of the entire multi-disciplinary research. This means importance of HCI is growing in government R&D and technologies in the future (Table 3).

Table 3. Comparing R&D spending on HCI categories (2009 vs 2013)

(USD, Million $)*	2009	2013	CAGR(%)
R&D in HCI categories	6.70	24.02	**37.62**
Multi-disciplinary R&D	1,486.16	2,994.32	**19.14**
Government R&D	11,337.03	15,445.92	**8.04**

*adapted annual average exchange rate in 2013 year (Korea Won (KW) to USD)

3.2 Characteristics of R&D

The result of comparison analysis in terms of technological maturity shows that relative ratio of the basic research subject increased by about 30 %. Also research in the "other stage" which means unclassified or across multi stage increased by 32.5 % and relative ratio of research in the introduction and growth stage decreased but still accounted for over 90 % except for "other stage". This means new research of complex technologies across different TLC stage increased (Table 4).

Table 4. Comparing ratio of research subjects in HCI categories by R&D stage and TLC (2009 vs 2013)

R&D stage	2009	2013	comparison	TLC stage	2009	2013	comparison
Basic research	40.9%	70.4%	**29.5%** ↑	**Introduction**	65.9%	50.9%	15.0% ↓
Applied research	34.1%	13.9%	20.2% ↓	**Growth**	29.5%	11.1%	18.4% ↓
Experimental development	25.0%	13.9%	11.1% ↓	**Maturity**	-	0.9%	0.9% ↑
Other	-	1.8%	1.8% ↑	**Decline**	-	-	-
				Other	4.5%	37%	**32.5%** ↑

The result of comparison analysis in terms of actor shows that relative ratio of research by university decreased, but still highest, and relative ratio of research by industry increased. This means diversity of agent conducting HCI R&D increased (Table 5).

Table 5. Comparing research-conducting agent of R&D on HCI categories (2009 vs 2013)

Conducting agent	2009	2013	comparison
University	70.1%	43.2%	**26.9%** ↓
GRI	22.1%	19.0%	**3.1%** ↓
Industry	5.7%	16.7%	**11.0%** ↑
Other	2.1%	21.0%	**18.9%** ↑

The result of comparison analysis in terms of technological field, namely 6T, shows that research in field of IT (Information tech.) decreased and CT (Culture tech.) increased (Table 6).

The result of comparison analysis in terms of research purpose shows that diversity of purpose of HCI R&D increased from 6 kinds in 2009 to 9 kinds in 2013. Ratio of research for industrial purpose was maintained highest. Among research for "industrial production and technology", main industries are "Electronic components, computer, video, sound and communication equipment (15.9 %('09) → 19.4 %('13)), "Publishing,

Table 6. Comparing technological field of R&D on HCI categories (2009 vs 2013)

6T	2009	2013	comparison	6T	2009	2013	comparison
BT	11.4%	10.2%	1.2% ↓	**CT**	18.2%	27.8%	**9.6%** ↑
IT	65.9%	54.6%	11.3% ↓	**ET, ST**	-		
NT	-	1.9%	1.9% ↑	**Other**	4.5%	5.6%	1.1% ↑

Table 7. Comparing socio-economic objective of R&D on HCI categories (2009 vs 2013)

Socio-economic objective of R&D	2009	2013	Comparison
Exploration and exploitation of the Earth	-	-	-
Environment	-	-	-
Exploration and exploitation of space	-	-	-
Transport, telecommunication and other infrastructures	-	0.9	0.9% ↑
Energy	-	-	-
Health	13.6	4.6	9.0% ↓
Agriculture	4.5	-	4.5% ↓
Education	-	0.9	0.9% ↑
Culture, recreation, religion and mass media	4.5	6.5	2.0% ↑
Political and social systems, structures and processes	-	3.7	3.7% ↑
General advancement of knowledge	11.4	5.6	5.8% ↓
Defense	-	-	-
Other public purpose	2.3	12.0	9.7% ↑
Industrial production and technology	63.7	63.0	0.7% ↓
Other Industrial purpose	-	2.8	2.8% ↑

video, broadcast communications and information services (18.2 % → 18.5 %)", "Professional scientific and technical services (6.8 % → 3.9 %)", "Arts, sports and recreation related services (4.5 % → 2.8 %)", "Medical, precision and optical instruments and watches (6.8 % → 2.8 %). Also, "Healthcare and social welfare services (2.8 % in '13)", "Education services (1.9 % in '13)", "Vehicles and transport equipment (0.9 % in '13) are newly emerged purposes (Table 7).

4 Conclusion

The change in scale of HCI related research has increased HCI's importance in Korea's national research and development and will strengthen HCI's role in future. It also provides implications for the further promotion of policies. Considering the high growth rate of the scale of HCI research funds, it becomes clear that HCI's relative importance to Korea's national research and development will increase rapidly.

Especially relative ratio of basic research as well as new and complex research carried out by universities as well as industries has been high or increased. This means that the base of research systems have been strengthen and that it is very probably that HCI research will consistently be expanded. As a consequence, policies that efficiently create and spread research outcomes have become essential. This further means that the CT area among 6T has gained great relative importance among the characteristics of the main technological field. As regards the economic and social objectives of research, this study showed that the objectives of the public sector as well as the industrial sector are becoming more and more diversified. These changes demonstrate that there's a possibility for HCI to become widely used in society which farther means that it is important to establish a legal framework, and introduce policies to develop the infrastructure that is needed for such a development. Last but not least, from an industrial perspective it is necessary to persistently work on the needed system and monitor the environmental changes of industries that have emerged as main fields of application.

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