

Koo ,Hyunmo; Kim, Seongcheol; Nam, Changi

Conference Paper

Speaker Wars begins: Which applications will be the killer content for smart speaker?

14th Asia-Pacific Regional Conference of the International Telecommunications Society (ITS): "Mapping ICT into Transformation for the Next Information Society", Kyoto, Japan, 24th-27th June, 2017

Provided in Cooperation with:

International Telecommunications Society (ITS)

Suggested Citation: Koo ,Hyunmo; Kim, Seongcheol; Nam, Changi (2017) : Speaker Wars begins: Which applications will be the killer content for smart speaker?, 14th Asia-Pacific Regional Conference of the International Telecommunications Society (ITS): "Mapping ICT into Transformation for the Next Information Society", Kyoto, Japan, 24th-27th June, 2017, International Telecommunications Society (ITS), Calgary

This Version is available at:

<https://hdl.handle.net/10419/168505>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.

Speaker Wars begins:

Which applications will be the killer content for smart speaker?

Hyunmo, Koo^a, Seongcheol, Kim^b, Changi, Nam^c

Abstract

Smart speakers have become next big thing in IoT industry. However, there is not enough discussion about which application would be killer content in smart speaker market. To boost market participation and the growth of the market, there should be a research predicting killer service in the smart speaker. This study uses an AHP model and framework to assess the priority for applications in smart speakers. This study compares three types of applications – Music, News, E-commerce – to investigate the priority.

Keywords: Smart speaker, Artificial intelligence speaker, AHP, IoT

^a Student in Master's degree, School of Media and Communication, Korea University, Media Hall, 145, Anam-ro, Seongbuk-gu, Seoul 136-701, Republic of Korea

^b Professor, School of Media and Communication, Korea University, Media Hall, 145, Anam-ro, Seongbuk-gu, Seoul 136-701, Republic of Korea

^c Professor, Management Science, Korea Advanced Institute of Science And Technology(KAIST), N22, 291 Daehak-ro, Yuseong-gu, Daejeon 305-701, Republic of Korea

1. Introduction

The smart speaker market is rapidly growing. It has been hailed as the next big thing in ICT and media industry. After Amazon Echo had developed, Samsung, Google, and Microsoft joined the market or acceded to a consortium to develop artificial intelligence or voice-controlled speaker. News companies described this market as the battlefield because all the leading ICT companies in the world enter this market. Voice Labs (2017) reported voice applications drives consumer demand for smart speakers. That is why Apple and Amazon opened a gate for third-party developers (Forbes, 2016). So, it is important for firms and developers to create applications to boost the market.

Smart speaker market in Korea is now emerging. In this context, it would be very effective for developers or firms to predict which applications should be in priority to develop. Secondly, this study is a process to ask experts to judge which criteria are superior to others. It could be a reference to further researches about applications in smart speakers. Policy makers in the government or decision makers in the universities or firms could make policies or decisions regarding this study. Lastly, this study could be a cornerstone for researchers to conduct comparative studies with foreign countries. This study asks Korean experts to do the analytical decision making. After this study, researchers could find out a difference between Korean and foreign countries and predict how the market shapes in the future. Thus, it is meaningful to look into which will be the killer content in smart speaker ecosystem.

This study aims to identify which applications would be the most promising content of smart speaker market. This study adopts Analytic Hierarchy Process (AHP) model for assessing the viability of contents in the smart speaker ecosystem. The model was applied to discuss the

prospect of three types of contents in smart speaker – Music, News & Podcast, E-commerce & Shopping – which are available in the present.

Ultimately, this study can help decision makers in the company to choose what to produce and prioritize applications.

2. Overview

A smart speaker has many names including voice-controlled speaker or artificial intelligent speaker or digital assistant speaker. Also, there is no single definition about the smart speaker because it is a relatively new concept.

Usually, a smart speaker means a hands-free speaker powered with digital voice assistants using two-way voice computing technology based on cloud computing (Amazon, 2017; Martin, 2017). So, users do not have to rely on smartphones or touch any devices to make an order through the smart speaker. Users can order Uber or search information or order food or listen to music or news or control any smart devices connected to home.

Amazon entered the market as it introduced 'Amazon Echo' in 2014. Then, Google introduced 'Google Home' in 2016 and Apple also plans to move forward with smart speaker market to rival Amazon and Google (Condcliffe, 2017). Gartner (2016) predicted that the market size would grow to 2 billion dollars by 2020. The market will increase 500% from 2015. Indeed, Amazon doubled its Echo sales from 2015 to 2016. The sales of Echo in 2015 was about 2.4 million units, and the sales became doubled 2016 recording 5.2 million units (Dunn, 2016). The reason why smart speaker market grows is that of IoT's growth. Smart speakers are regarded as a key to control home IoT system (The New York Times, 2016). Additionally, content

providers regard a smart speaker as a new way to attract the audience. Indeed, many news companies in the US has already invested audio contents to be broadcasted in smart speakers.

The same phenomenon also happens in Korea. In Korea, SKT, KT, who are South Korean wireless telecommunication companies, also unveiled their voice-controlled artificial intelligence speaker (Financial News, 2017). Naver, which owns the biggest web portal in Korea, also plans to produce a smart speaker in 2017 (Kim, 2016). Samsung Electronics also associates with Microsoft to develop own smart speaker (VentureBeat, 2016). Many consulting firms predict the competition would be severe as more companies enter this market because the smart speaker is regarded as de facto technology to be the herb in IoT (Internet of Things) technology (IHS Markit, 2017).

Contrary to the significance of smart speaker market, there were no researches about what would be the killer application in smart speaker market. Previous researches (Moon, Kim & Shin, 2017; Moskvitch, 2017; Kim, Hong, & Chung, 2010; Kalafarski, 2007) focused on the effect of smart speakers in IoT market, practical usages, technology patents.

In the industry field, firms researched the potential growth of the market size. Indeed, even though there were few kinds of research about smart speakers because it is a recent concept, there were no researches about the content in smart speaker ecosystem in Korea.

3. AHP modeling and framework

3.1. AHP method

This study uses Analytic Hierarchy Process (AHP) to analyze and discover the prospect of smart speaker contents (Saaty, 1990). AHP can be a tool to structuralize and analyze factors affecting the business decision-making process. AHP can help researchers to prioritize development vision or examine strategic priority. It also can be used to prioritize contents as a market choice.

Usually, AHP consists of objective goals, criteria, and alternatives. The goal of AHP is to determine the relative strength of each alternative and to prioritize them. In this sense, AHP can help to prioritize and to predict the killer contents by examining contents with multiple criteria (Kim & Kim, 2015; Yang et al., 2007).

There are four major criteria usually involved in general criteria. Advantages, opportunities, risks and disadvantage are frequently used as the upper layer (Bayazit, 2005). Regarding the fact that smart speakers are innovative products, this study also considers criteria to evaluate innovative services. Productivity, economic competitiveness, and the quality of life are important criteria for innovative services (Miles, 2006). Technology prospect, market potential, and regulation environment are regarded as the powerful factors of diffusion and performance of innovative products and services. They influence each other and the market at the same time (Baumgärtner & Winkler, 2003).

Combining previous literature, this study draws three criteria to evaluate the priority to develop applications on smart speakers. Three forces to be examined in this study are user benefit, market value, user risk. In other words, the priority of developing applications for smart speakers would be dependent on user benefit, market value, and user risk. User benefit criteria are based on advantages and user aspects, and market value criteria are based on opportunities and market potential and user risk criteria is based on risks, disadvantage, and technology.

To collect data, this study would take a survey on, at least, 20 experts in ICT and media market field. Experts would be carefully selected by their knowledge background in the ICT industry. Survey participants would consist of people from the telecom company, private companies in ICT industry, public research institutes in Korea, professors from universities, journalists from a business newspaper.

3.2. Criteria

This study uses Analytic Hierarchy Process (AHP) to analyze and discover the prospect of smart speaker contents (Saaty, 1990). AHP can be a tool to structuralize and analyze factors affecting the business decision-making process. AHP can help researchers to prioritize development vision or examine strategic priority. It also can be used to prioritize contents as a market choice.

There are three criteria including user benefit, market value, and user risk in the first layer. Each criterion in the first layer has several sub-criteria in the second layer.

3.2.1. User benefit

Services should provide users with lots of benefits to be successful. Assessment of user satisfaction is reported as a measurement of success for services (Bokhari, 2005). In this sense, applications on smart speakers should provide users with benefits to be successful services. This study approaches user benefit regarding diverse users' life of quality. Innovative products like smart speakers can meet the expectation to be helpful users. They have the power to improve the quality of lives of users including people with disabilities and to accelerate user's activities that

enhance the personal quality of life (Cai & Abascal, 2006). In this sense, this study defined user benefit as a degree to improve users' quality of life.

3.2.1.1. Personal quality of life. Innovative services should be positively perceived as something useful and easy to enjoy to be accepted by potential users (Davis, 1993). For a new service to be accepted by potential users, applications should improve users' personal quality of life because applications should be helpful to be sold to many users. In other words, applications should improve personal quality of life enough for a service to make a success. No matter how potentially profitable the service is, the service will fail if the user does not feel that applications improved their lives or not. Low levels of improving ones' life are a kind of signals of failure for service providers (Hung, Chang & Yu, 2006). Therefore, applications should increase user's personal quality of life higher enough to be a successful service.

3.2.1.2. Family's quality of life. Even though smart speakers provide users with many personal services, speakers are designed as a tool for families. So, smart speakers are digital devices equipped with digital assistants and household devices for family simultaneously. Smart speakers are regarded as the first device in homes which will listen to people's requests in the house (Phys.org, 2016). MIT Technology Review (2016) said smart speakers are digital butlers for users' family located in the home. Innovative, new systems should include normative values for families and communities to create diverse human values in the world (Saaty & Shang, 2011). In this sense, applications for speakers should improve family members' quality of life to make a success.

3.2.1.3. People with special need's quality of life. There are many users using smart speakers from normal users to users having special needs (Karim, & Tjoa, 2006) For the people with special needs, such as the old, the disabled, smart appliances are potential game changers. People who are hard of seeing something, couldn't take advantage of smartphones or devices yet (Fortune, 2015). However, smart speakers could be an enormous benefit to many disabled people because smart speakers provide people services operated only by voices.

Additionally, people who are not good at using newly digital devices can enjoy smart speakers thanks to the ease of use and convenience. In this sense, smart speakers are regarded as a tool to solve social problems. Therefore, applications which improve the quality of life of people with special needs more have greater user benefit.

3.2.2. Market value

Even though it is foreseen the market of smart speakers will grow, no one knows how speakers and applications will make a growth. The market value of smart speakers' applications should be guaranteed to enroll many stakeholders to make the market bigger. To achieve this goal, applications should have an own business model, the probability of boosting smart speakers' sale, the probability of opening windows the on derivative market. If applications cannot meet those criteria, the business will not be sustainable.

To develop a successful service, it is necessary to measure the demand of the market and the service which does not take into consideration the demand of the market has to fail.

Researchers argued that market demand is a kind of a term for wishes for customers having purchasing power (Edvardsson & Olsson, 1996; Matthing, Sandén & Edvardsson, 2004). To be successfully developed, services should have market demand and recognized as attractive

enough to buy for customers. In this sense, services with higher market demand have higher market value, and those services would be regarded as an appropriate alternative in the lowest layer.

3.2.2.1. Application's business model. The most important thing when developing a service is the sustainability of the service. Sustainability comes from the business model, and the service needs to be developed considering the possibility of building business models. According to Zott & Amit (2010), business models mean the way how to provide customers and end-users with products and services. It also consists of ways how to create and deliver value through services and commercialization (Johnson, Christensen & Kagermann, H. (2008). Steward & Zhao (2000) argued that business model is a concept which has been widely accepted as a critical factor for companies to make a success.

3.2.2.2. Boosting smart speakers' sale. The most important factor affecting smartphone purchase decision is community, needs, and software (Osman, 2012). Hwang (2012) also found out that smartphone applications significantly influence smartphone usage and purchase. The application market is a multilayer two-sided platform for software developers, device manufacturers, and OS developers. More applications attract more end-users, more end-users mean more device sales and more device sales naturally happens to more application sales (Lin & Ye, 2009).

Applications which can attract more users to increase sales of devices are preferred in the market thanks to the characteristics of the two-sided platform (Frank & Shivendu, 2013) In this sense, applications which are likely to boost smart speakers' sales are likely to be successful applications.

3.2.2.3. Windows on the derivative market. Market potential and market value are strongly tied to opportunity windows which are an extent to open opportunities on derivative markets. Derivative market is a new market for related products, services, applications (Cooper & Kleinschmidt, 1987). For example, derivative products for smart speakers are smart home appliances. Also, smartphones opened the new window for derivative services like O2O services or emoticons. Traditionally, innovative products have a characteristic to open new windows of new products and new markets for the firm (Kleinschmidt & Cooper, 1991). Indeed, manufacturers for smart speakers are chasing the smart-home market which is estimated to be a \$71 billion industry in the global by 2018 (CBS News, 2016). So, applications having more probability to open windows on derivative markets are likely to succeed in the market and make much more market value rather than other applications.

3.2.3. User risk

Smart speakers are located in the most private space of the user, contain a variety of personal information, and because of the recent incidents and accidents related to smart speakers, users would be highly sensitive to services with expected risks. So, user risks should be considered as a factor affecting service development. In this sense, the possibility of user risk would be negative for companies to develop services regarding costs and regulations.

3.2.3.1. Privacy concern. There has been a discussion about privacy concern because of consumer protection. According to recent news (The Guardian, 2015), smart speakers are not perfect and sometimes dangerous for consumers because of privacy problems. Indeed, according

to several articles, there are worries for consumers about privacy concern (Slate, 2016). Those worries would provoke users' resistance to use services or speakers. For a new service to come to a stable orbit, the user's resistance to using must be low. In other words, user acceptance should be high enough for a service to make a success. No matter how potentially demanding the service be, the service fails if the user does not accept it. Low levels of user acceptance of services are a kind of signals of failure for service providers (Hung, Chang & Yu, 2006). Services which could provoke privacy concern would have a negative impact so that they would fail to obtain social justification. Therefore, consumers would have a better image for a service that is committed to protecting privacy, and a good image will lower the users' resistance to use.

3.2.3.2. Technological Reliability. It must be technically stable so that the service can be maintained and developed. Technically unstable services can lead to inefficient development because the services are less sustainable due to the technology reliability problem. Services' technological reliability could be a hurdle when implementing and diffusing a service for smart speakers. Also, users and communities in the society will not adopt services or could regulate such services if services are not reliable (Mattern & Floerkemeier, 2010). In this sense, services with high risk which is hard to achieve the reliability would not be an attractive option for service providers and users.

3.3. Alternatives

This study draws three alternatives from existing reviews about application usages in smart speakers.

3.3.1. Music applications

The first one is music application. According to Voice Labs (2016), music is most frequently used service in smart speakers. Consumers who bought Amazon Echo or Google Home chose music as a reason why they like smart speakers. Smart speakers can play, find music for users. Billboard (2016) said there would be a streaming-music war into living rooms through smart speakers. That is why the music business put an emphasis on smart speakers. Therefore, music application is chosen as the first alternative.

3.3.2. News & Podcast applications

According to Voice Labs (2016), people use smart speakers to play music, game and listen to news or podcasts. Even though music is regarded as a killer application, for now, news and podcasts are regarded as a game-changer for the audio content market (The Podcast Host, 2016). The Guardian (2016) predicted the technology could change how people consume news. Following this trend, The Wall Street Journal launched news service on Google Home and Amazon Echo (DOW JONES, 2017). Naver also opened a plan to invest \$ 30 million in news and audio contents (Etnews, 2017). Therefore, news and podcasts are selected as an alternative.

3.3.3. E-commerce & Shopping applications

Traditionally, online retailers regard smart speakers as a way to benefit from new technology. Truly, shopping through voice control has made smart speakers attractive to users (IoT Now, 2017). Also, e-commerce was pointed out to be the reason why Amazon started to invest smart speaker market (The Motley Fool, 2017). Business Insider also argued that full

potential of smart speaker lies in shopping and e-commerce services (Business Insider, 2015). Google also announced that it plans to include several features to make users buy many items through Google Home more easily (Digital Commerce 360, 2017). SKT, which is a leading company in Korean smart speaker market, tries to deploy several applications related to shopping in its speaker, NUGU (ChosunBiz, 2017). So, e-commerce and shopping application is chosen as an alternative. The model is described in Fig.1.

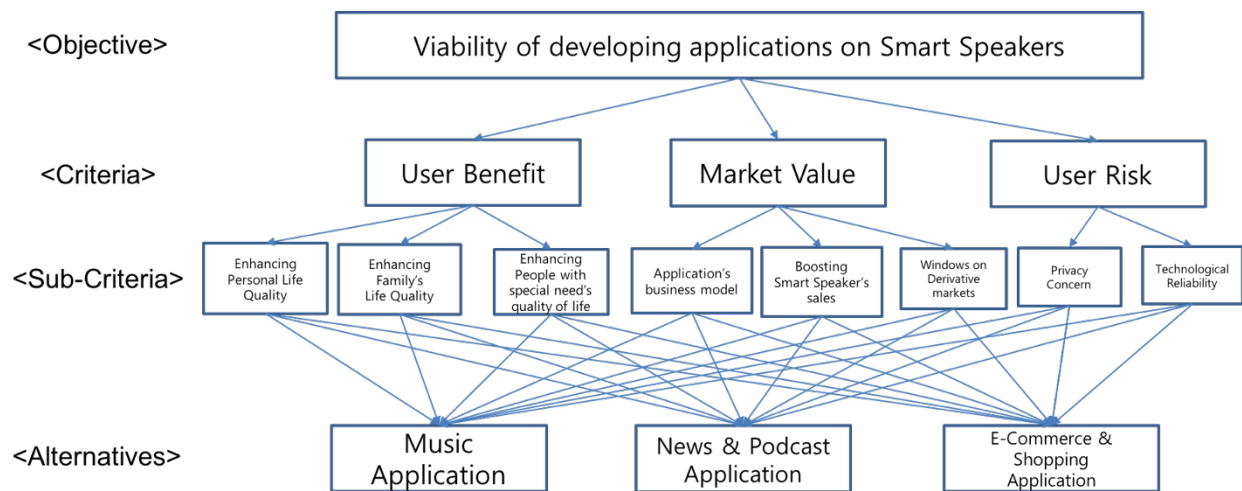


Fig. 1 Viability of developing applications on Smart Speakers

4. Methodology

4.1. Data Collection

The suggested AHP model would be tested through survey among experts. The experts would consist of people having specialties in ICT and media industry. Respondents would be selected by their expertise, knowledge background in the ICT industry. Participants would come from private companies in ICT industry such as telecom companies, internet companies.

Researchers in national public institutes and professors from universities would be included as participants

4.2. Data Analysis

This study uses MatLab to analyze the data from the survey. The computation code would be borrowed from Kim and Nam (2014).

5. Results and Discussion

To be updated

6. Implications

To be updated

Acknowledgements

This research was supported by National Research Foundation (NRF) of South Korea grant funded by the Korean government [NRF-2016S1A3A2924760].

References

- Amazon. (2017). Amazon Echo-Black, <https://www.amazon.com/Amazon-Echo-Bluetooth-Speaker-with-WiFi-Alexa/dp/B00X4WHP5E>
- Baumgärtner, S., & Winkler, R. (2003). Markets, technology and environmental regulation: price ambivalence of waste paper in Germany. *Ecological Economics*, 47(2), 183-195.
- Bayazit, O. (2005). Use of AHP in decision-making for flexible manufacturing systems. *Journal of Manufacturing Technology Management*, 16(7), 808-819.

- Benston, G. J. (2000). Consumer protection as justification for regulating financial-services firms and products. *Journal of Financial Services Research*, 17(3), 277-301.
- BillBoard. (2016). Amazon Echo vs. Google Home: Which Speaker Is the Smart Choice for Music Listeners?, <http://www.billboard.com/articles/business/7588922/amazon-echo-google-home-smart-speakers-music>
- Bokhari, R. H. (2005). The relationship between system usage and user satisfaction: a meta-analysis. *Journal of Enterprise Information Management*, 18(2), 211-234.
- Braun, E., & Wield, D. (1994). Regulation as a Means for the Social Control of Technology. *Technology Analysis & Strategic Management*, 6(3), 259-272.
- Business Insider. (2015). Why Amazon's Echo, the smart-home assistant, could launch a whole new device category, <http://www.businessinsider.com/amazon-echo-smart-home-assistant-2015-4>
- Cai, Y., & Abascal, J. (2006). Ambient intelligence in everyday life. Berlin: Springer.
- CBS News. (2016). Does your home really need "smart speakers"?, <http://www.cbsnews.com/news/does-your-home-really-need-smart-speakers/>
- Charles, R. P., Davis, K. W., & Smith, J. L. (2005). Assessment of concentrating solar power technology cost and performance forecasts. Sargent & Lundy LLC, Technical Report.
- ChosunBiz. (2017). SKT, 'Who' AI voice shopping era opens ... Introduces 5 daily recommended products, http://biz.chosun.com/site/data/html_dir/2017/03/30/2017033002421.html
- Condliffe, J. (2017). Alexa has won CES, but it may not win the smart assistant war. *MIT Technology Review*. <https://www.technologyreview.com/s/603317/alexa-may-have-won-ces-but-it-still-has-a-fight-ahead/>
- Cooper, R. G., & Kleinschmidt, E. J. (1987). New products: what separates winners from losers?. *Journal of product innovation management*, 4(3), 169-184.
- Digital Commerce 360. (2017). The voice-based search battle in retail has just begun, <https://www.digitalcommerce360.com/2017/03/21/the-voice-based-search-battle-in-retail-has-just-begun/>
- Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS quarterly*, 319-340.
- DOW JONES. (2017). Wall Street Journal Launches on Amazon Alexa and Google Assistant on Google Home, <https://www.dowjones.com/press-room/wall-street-journal-launches-amazon-alexa-google-assistant-google-home/>

- Dunn, J. (2016). It's been a good year for the Amazon Echo. *Business Insider*,
<http://www.businessinsider.com/amazon-echo-sales-figures-stats-chart-2016-12>
- Edvardsson, B., & Olsson, J. (1996). Key concepts for new service development. *Service Industries Journal*, 16(2), 140-164.
- Etnews. (2017). Naver Smart Speaker comes out ... Spurred on securing voice technology and contents,
<http://www.etnews.com/20170126000389>
- Financial News. (2017). Alexa said she's a ' universal AI secretary, ' and NUGU and Genie is still fledgling,
<http://www.fnnews.com/news/201703261759223146>
- Forbes. (2016). Report: Apple Is Working On Smart Speaker To Rival Amazon Echo,
<https://www.forbes.com/sites/aarontilley/2016/05/24/report-apple-is-working-on-smart-speaker-to-rival-amazon-echo/#179199ac7658>
- Fortune. (2015). For the disabled, smart homes are home sweet home, <http://fortune.com/2015/02/01/disabled-smart-homes/>
- Frank MacCrory & Shivendu Shivendu. (2013). Multilayer Two-Sided Platforms: The Role of Exclusive Contracts. *In Proceedings of the 2013 46th Hawaii International Conference on System Sciences (HICSS '13)*. IEEE Computer Society, Washington, DC, USA, 1474-1482
- Gartner. (2016). Gartner Says Worldwide Spending on VPA-Enabled Wireless Speakers Will Top \$2 Billion by 2020. <http://www.gartner.com/newsroom/id/3464317>
- Grabowski, H. G., & Vernon, J. M. (1977). Consumer protection regulation in ethical drugs. *The American Economic Review*, 359-364.
- Hwang, C.-S. J. (2012). Investigation toward smartphone users' need before develop mobile application. doi: 203.71.232.26
- Hung, S. Y., Chang, C. M., & Yu, T. J. (2006). Determinants of user acceptance of the e-Government services: The case of online tax filing and payment system. *Government Information Quarterly*, 23(1), 97-122.
- IHS Markit. (2017). Google Assistant Will Eventually Prevail Against Amazon's Alexa in Smart Speakers, Virtual Assistant Space. <http://news.ihsmarkit.com/press-release/technology/google-assistant-will-eventually-prevail-against-amazons-alexa-smart-speaker>

- IoT Now. (2017). Smart thinking: Smart watches and speakers will be the next retail battleground, says Fastlane, <https://www.iot-now.com/2017/05/08/61369-smart-thinking-smart-watches-speakers-will-next-retail-battleground-says-e-commerce-expert/>
- Jaffe, A. B., Newell, R. G., & Stavins, R. N. (2005). A tale of two market failures: Technology and environmental policy. *Ecological economics*, 54(2), 164-174.
- Johnson, M. W., Christensen, C. M., & Kagermann, H. (2008). Reinventing your business model. *Harvard business review*, 86(12), 57-68.
- Kalafarski, S. C. (2007). U.S. Patent No. 7,170,396. Washington, DC: U.S. Patent and Trademark Office.
- Karim, S., & Tjoa, A. M. (2006). Towards the use of ontologies for improving user interaction for people with special needs. In *International Conference on Computers for Handicapped Persons* (pp. 77-84). Springer Berlin Heidelberg.
- Kim, S., & Kim, S. (2016). A multi-criteria approach toward discovering killer IoT application in Korea. *Technological Forecasting and Social Change*, 102, 143-155.
- Kim, S., Nam, C., (2014). N-screen hwan-gyeong-e-seo news content yutong jeollyak mit digital news saengtaegye gaeseon bang-an yeon- gu (Research for News Content Distribution Strategy and Digital News Ecosystem Reform in N-Screen Environment). *Korea Press Foundation*, 2014-02.
- Kim, T., Hong, S. H., & Chung, Y. (2010). A hardware framework for smart speaker control of home audio network. *IEEE Transactions on Consumer Electronics*, 56(4).
- Kim, Young-won. (2016). Naver to roll out AI assistant to trump Google. Korea Herald. <http://www.koreaherald.com/view.php?ud=20160628000961>
- Kleinschmidt, E. J., & Cooper, R. G. (1991). The impact of product innovativeness on performance. *Journal of product innovation management*, 8(4), 240-251.
- Lin, F., & Ye, W. (2009). Operating system battle in the ecosystem of smartphone industry. In *Information Engineering and Electronic Commerce, 2009. IEEEC'09. International Symposium on* (pp. 617-621). IEEE.
- Martin, Erik J. (2017). How Echo, Google Home, and Other Voice Assistants Can Change the Game for Content Creators. *EContent*, 40(2), 4-8.
- Mattern, F., Floerkemeier, C., 2010. From the Internet of computers to the internet of things. From Active Data Management to Event-Based Systems and More. Springer, Berlin Heidelberg, pp. 242–259

- Matthing, J., Sandén, B., & Edvardsson, B. (2004). New service development: learning from and with customers. *International Journal of Service Industry Management*, 15(5), 479-498.
- Miles, I. (2006), "Innovation in services", in Fagerberg, J., Mowery, D.C. and Nelson, R.R. (Eds), *The Oxford Handbook of Innovation*, Oxford University Press, Oxford, pp. 433-58.
- MIT Technology Review, (2016). In 2016, AI Home Assistants Won Our Hearts, <https://www.technologyreview.com/s/603228/in-2016-ai-home-assistants-won-our-hearts/>
- Moon, Y., Kim, K. J., & Shin, D. H. (2016). Voices of the Internet of Things: An Exploration of Multiple Voice Effects in Smart Homes. In *International Conference on Distributed, Ambient, and Pervasive Interactions* (pp. 270-278). Springer International Publishing.
- Moskvitch, K. (2017). The Internet of Things 2.0: when things start to listen. *Engineering & Technology*, 12(1), 63-65.
- Osman, M., 2012. A study of the trend of Smartphone and its usage behavior in Malaysia. *International Journal on New Computer Architectures and Their Applications*, 2(1): 274-285.
- Phys.Org. (2016). Amazon, targeting smart homes, adds devices to 'Alexa' family, <https://phys.org/news/2016-03-amazon-amplifies-alexa-line-voice-controlled.html>
- Pogue, D. (2017). Your Echo Is Listening. *Scientific American*, 316(3), 28.
- Robertson, T. S. (1967). The process of innovation and the diffusion of innovation. *The Journal of Marketing*, 14-19.
- Saaty, T. L. (1990). How to make a decision: the analytic hierarchy process. *European journal of operational research*, 48(1), 9-26.
- Saaty, T. L., & Shang, J. S. (2011). An innovative orders-of-magnitude approach to AHP-based multi-criteria decision making: Prioritizing divergent intangible humane acts. *European Journal of Operational Research*, 214(3), 703-715.
- Shim, J. P., Shin, S., & Weiss, M. B. (2006). Digital multimedia broadcasting (DMB): Standards, competition, and regulation in South Korea. *JITTA: Journal of Information Technology Theory and Application*, 8(2), 69.
- SK. (2016). SK Telecom Introduces Artificial Intelligence Service NUGU, <http://www.sk.com/Channel/News/view/1384>

- Slate. (2016). An Amazon Echo May Help Solve a Murder. That Should Worry Privacy Advocates,
http://www.slate.com/blogs/future_tense/2016/12/27/amazon_s_echo_may_help_solve_a_murder_which_s_hould_worry_privacy_advocates.html
- Stewart, D.W., Zhao, Q., (2000). Internet marketing, business models, and public policy. *J. Public Policy Mark.* 19 (2), 287–296
- TalkAndroid, (2017). Convergence on the way to Google Home, <http://www.talkandroid.com/312907-convergence-on-the-way-to-google-home/>
- The Guardian. (2016). Introducing the Guardian skill for Alexa,
<https://www.theguardian.com/help/insideguardian/2016/sep/28/introducing-the-guardian-skill-for-alexa>
- The Guardian. (2015). Goodbye privacy, hello 'Alexa': Amazon Echo, the home robot who hears it all,
<https://www.theguardian.com/technology/2015/nov/21/amazon-echo-alexa-home-robot-privacy-cloud>
- The Motley Fool. (2017). 4 Reasons Amazon Is Winning the Smart Speaker Wars,
<https://www.fool.com/investing/2017/03/17/4-reasons-that-amazon-is-winning-the-smart-speaker.aspx>
- The New York Times. (2016). Google Home vs. Amazon Echo: A Face-Off of Smart Speakers,
<https://www.nytimes.com/2016/11/04/technology/personaltech/google-home-vs-amazon-echo-a-face-of-f-of-smart-speakers.html>
- The Podcast Host. (2016). THE AMAZON ECHO: A GAME CHANGER FOR PODCASTING?,
<https://www.thepodcasthost.com/listening/amazon-echo-podcasting/>
- VentureBeat. (2016). Samsung's Harman Kardon will release an Alexa competitor with Cortana in 2017,
<https://venturebeat.com/2016/12/13/samsungs-harman-kardon-will-release-an-alexa-competitor-with-cortana-in-2017/>
- Voice Labs. (2017). The 2017 Voice Report by VoiceLabs, <http://voicelabs.co/2017/01/15/the-2017-voice-report/>
- Willey, Z. (1982). Economic Criteria in Environmental Regulation: Prospects for the 1980s. *American Journal of Agricultural Economics*, 64(5), 935-941.
- Yang, D. H., Kim, S., Nam, C., & Min, J. W. (2007). Developing a decision model for business process outsourcing. *Computers & Operations Research*, 34(12), 3769-3778.
- Zott, C., & Amit, R. (2010). Business model design: an activity system perspective. *Long range planning*, 43(2), 216-226.