

Technology Upgrade Analysis for Digital Terrestrial Television Policy in Taiwan

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Abstract — Although the transition of digitalization wireless TV was completed in 2012, the National Communications Commission (NCC) is going to upgrade broadcasting technology from DVB-T to DVB-T2 for enabling more HDTV channels and enriching contents in the second stage license release plan. For further study of DTT upgrade policy to figure out what are critical factors that affect the whole industry development and viewers and broadcasters do care about, we collected relevant information and interviewed people in this field to proceed discuss the Analytical Network Process (ANP). According to the contents of the interview, the research model is composed of TV viewers, DTT broadcasters, and policy makers. The questionnaires results indicate that “viewers” receives the most attention. “Content variety”, “government support/requirements”, “laws and regulations” are important in these dimensions.

I. INTRODUCTION

Based on global perspective TV broadcasting industry, there is a considerable degree of variation within the competition between wireless TV and cable TV. In Korea, three main broadcasting stations, MBC, KBS, and SBS, dominate 70% of viewing rate of the TV industry [4]. In Britain, most households watch TV through wireless TV or satellite TV. Before digitalization, there were 60% of viewers watching terrestrial TV; however, the market share of cable TV occupied only 13% [5]. In Taiwan, the situation of TV industry is totally different from the above countries; most people watch TV through the cable system and its viewing rate is up to 85% comparing with 15.4% of terrestrial TV [6]. It is much more alike the TV industry in Netherland, 93% of cable TV and only 4% of terrestrial TV [7]. The viewing rate could be an important decision making factor concerning technical standard upgrade. With the limited market share of DTT, national communications regulatory authorities (NCRA) in Taiwan has to evaluate DTT upgrade technology with different considerations and designs upgrade policy matching our own circumstances.

With the trend of global digitalization, some developed countries as the U.S. and European countries are at rapid pace of analog to digital transition since 2006. After that, the number of global digital TV viewer is increasing steadily and HDTV programs would be available. Owing to digital convergence, countries have paid attention to switch over digital terrestrial television (DTT) technology to accelerate

digitalization and enhance social welfares.

Due to the meaning of public interest for information transmission, disaster prevention, and emergency rescue of DTT, it is essential to maintain the existence of wireless TV in Taiwan. With the development of DTT in Taiwan, the issue of next generation standard is interesting and worthy of being discussed. The changes for equipment suppliers, content industries, consumers, government policies, and etc. are factors to be considered in the DTT standard switchover.

Our research finds out the critical factors affecting the DTT decision making by ANP and apply the outcomes to offer suggestions and implications of DTT development to the NCRA, DTT broadcasters and researchers.

II. ANALYTIC NETWORK PROCESS

The analytic network process (ANP) is a tool for multi-criteria decision making. The ANP incorporates qualitative and quantitative approaches to a decision problem. Besides, the ANP is effective to deal with complex decisions where interdependence exists in a decision model.

The ANP is composed of two parts. The first consists of a control hierarchy or network of criteria and sub-criteria that control the interactions. The second is a network of influences among the elements and clusters. Many decision problems involve the interaction, inner dependence and outer dependence. The outer dependence is the dependence between components but in a way to allow for feedback circuits and the inner dependence is the interdependence within a component combined with feedback components. Therefore, they cannot be structured hierarchically but be generalized to networks in the ANP.

The SuperDecisions is software used to implement the analytic network process. It is developed by Dr. Thomas Saaty and uploaded on the official website (<http://www.superdecisions.com/>), making it easier for researchers to use.

A. Problem Definition and Model Construction

The decision problem should be defined clearly in the first place. And it should be constructed on a system network. The relevant criteria and alternatives are structured in the form of a control hierarchy, and the topmost elements are decomposed into subcomponents and attributes [1].

B. Questionnaire Design and Pairwise Comparison

The experts' questionnaire is used to acquire the point of view from the professionals in the specific field. To make tradeoffs among the many objectives and criteria, the

opinions are expressed numerically [2]. The dimensions need to be evaluated according to the fundamental scale of the ANP [3]. Decision elements at each cluster are compared pairwise according to their importance towards their control criteria. And the clusters are pairwise compared based on their contribution to the goal. The importance values contain nine scales (as TABLE I). Pairwise comparison which includes external dependency and internal dependency is used to compare different factors. While one element is X times important relative to another, the inverse comparison is made by assigning the latter element the reciprocal value $1/X$.

TABLE I
THE FUNDAMENTAL SCALE OF ABSOLUTE NUMBERS

Intensity of Importance	Definition	Explanation
1	Equal importance	Two indicators are equally important
2	Weak	Intermediate
3	Moderate importance	Slightly important than the other
4	Moderate plus	Intermediate
5	Strong importance	Strongly important than the other
6	Strong plus	Intermediate
7	Very strong or demonstrated importance	Very strongly important than the other
8	Very, very strong	Intermediate
9	Extreme importance	Highest possible order than the other

(Sources: Saaty & Vargas, 2006 [3]; Sun, 2012 [8])

C. Eigenvalues, Eigenvectors, and Consistency Test

We obtain the eigenvalues and eigenvectors and implement the consistency test to make sure the effectiveness of the results by the SuperDecisions. It is rationale that the C.R. is less than or equal to 0.1, which represents the consistency. However, if the C.R. is larger than 0.1, it is better that the questionnaire be modified [8].

D. Super Matrix

To deal with the interdependence of factors within the problem, the ANP applied a super matrix to calculate the relative weights among factors. Multiply the unweighted super matrix by pairwise comparison matrix of the criteria, we obtained eigenvectors of the weighted super matrix. Suppose that the performance indicators are dependent, we had a convergent value of limit matrix, which is the multiplication of the matrix itself many times. The values in the limit matrix are the weight of the factors [2].

III. RESULTS AND DISCUSSION

A. Interviews with Experts

To obtain objective opinions from both academic and practical perspectives, we interviewed experts from broadcasters, academics, and government officials. Among the digital terrestrial television broadcasters in Taiwan, we invited the person of each company who is in charge of the DTT-related issues to participate in the interview. These companies include Union of Public Television Service Foundation (PTS), Chinese Television System (CTS), and China Television Company (CTV). Also, we discuss the topic on the DTT development with the professors in National ChengChi University (NCCU) and government officials of the NCC.

When studying about the policy decision making, lots of dimensions and criteria need to be considered. We have interviewed broadcasters and the government officials in this research to gather the critical factors affecting the decision making process from their opinions. The factors are divided into different dimensions, and they are shown in Fig. 1.

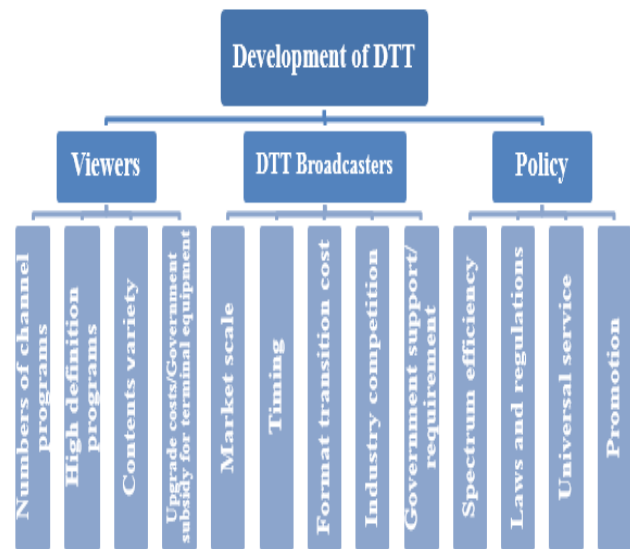


Fig. 1 Research model.

B. Questionnaire Analysis

The experts are composed of three different groups: industrial, academics and officials. Academics consist of scholars who have paid attention to the development of DTT for years. They came from National Chen Kung University (NCKU), National Chengchi University (NCCU). Government officials were from the NCC, including the technical specialist. And in the DTT industry, representatives of broadcasters included the manager in the marketing department of CTV and the supervisor in the engineering department of CTS.

After the recovery of the experts' questionnaire and the completion of pairwise comparison between/within

hierarchy, we implemented the integration of experts' preference. We calculated the geometric means of all the returned questionnaires to construct pairwise comparison matrices. And then, we computed the eigenvectors in each matrix. After that, we take the collected data into ANP decision making software, SuperDecisions, checked the consistency, and executed the examination later.

In the consistency test, we gathered the opinions on the questionnaires filled out by the experts introduced in the previous section. This research used SuperDecisions to check the consistency of the results of the pairwise comparison to make sure that all the factors could effectively explain how they affect the development of digital terrestrial television. The consistency is proven if the $C.R. \leq 0.1$. All the factors pass the consistency tests so that the results are valid.

The ranking and final weights of factors in the limit matrix are shown in TABLE II and Appendix A. As the research outcome shows, the contents are the most important issue viewers may concern. For DTT broadcasters, they need the support or requirements from the government. And the laws and regulations should be maturity enough to encourage the industry development. These results are what the broadcasters expect the DTT industry could be.

In a comprehensive perspective, the most critical factor of the development of DTT is "Contents variety", which is in accordance with the preliminary outcome of pairwise comparison between hierarchies. The "Viewers" is the key concern of development of DTT, ranking the highest among the other dimensions.

TABLE II
RANKING OF FACTOR WEIGHTS

Factors	weights	rank
Numbers of channel programs	0.051	11
High definition programs	0.114	2
Contents variety	0.157	1
Upgrade costs/Government subsidy for terminal equipment	0.075	6
Market scale	0.061	9
Timing	0.031	13
Format transition cost	0.043	12
Industry competition	0.062	8
Government support/requirement	0.070	7
Spectrum Efficiency	0.094	4
Laws and regulations	0.099	3
Universal service	0.089	5
Promotion	0.056	10

IV. CONCLUSION AND IMPLICATIONS

Policy decision making of DTT is a challenging task that requires the coordination of different kinds of interest conflicts, such as consideration of the environment, the market, the industry, technological progress and interests

and responses of stakeholders to achieve spectrum efficiency, and ensure DTT receiving rights and prosperity of industry development. The allocation of radio spectrum is a requisite of digital terrestrial television, so the NRA has to design the policy carefully to enable stable and sustainable development of DTT.

The current situation of DTT industry in Taiwan is not as prosperous as before due to the growth of cable TV which provides more attractive programs and contents. However, contents on DTT seem not so desirable and most of them are rerun. It makes sense that viewers are tired of what broadcasters supply because the contents are platitude. With the audience rate falls, advertisers could not be benefited from the DTT channels. With this context, it becomes a vicious circle that there are no sufficient viewing rates to offer advertisement revenues. With insufficient advertisement incomes, broadcasters could not invest on highly quality programs adequately and enable more HDTV channels.

In addition, whether the scale of Taiwan DTT market can support transition from DVB-T to DVB-T2 in this moment would be an issue. As for DTT contents, the Ministry of Culture should take response to encourage the high quality contents broadcasted over the air. Related laws and regulations must be established so as to assist and protect the development of DTT industry. Therefore, broadcasters or other stakeholders may have some guidance to follow.

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APPENDIX A. LIMIT MATRIX OF OVERALL EXPERTS

Goal	Dimension			Viewers			DTT Broadcasters			Policy							
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
B	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
C	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
D	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
E	0.051	0.076	0.023	0.025	0.128	0.128	0.128	0.128	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
F	0.114	0.171	0.051	0.057	0.287	0.287	0.287	0.287	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
G	0.157	0.235	0.071	0.078	0.396	0.396	0.396	0.396	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
H	0.075	0.112	0.034	0.037	0.189	0.189	0.189	0.189	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
I	0.061	0.041	0.135	0.043	0.000	0.000	0.000	0.000	0.229	0.229	0.229	0.229	0.229	0.000	0.000	0.000	0.000
J	0.031	0.021	0.069	0.022	0.000	0.000	0.000	0.000	0.117	0.117	0.117	0.117	0.117	0.000	0.000	0.000	0.000
K	0.043	0.029	0.095	0.030	0.000	0.000	0.000	0.000	0.161	0.161	0.161	0.161	0.161	0.000	0.000	0.000	0.000
L	0.062	0.042	0.138	0.044	0.000	0.000	0.000	0.000	0.232	0.232	0.232	0.232	0.232	0.000	0.000	0.000	0.000
M	.070	0.047	0.155	0.049	0.000	0.000	0.000	0.000	0.261	0.261	0.261	0.261	0.261	0.000	0.000	0.000	0.000
N	0.094	0.063	0.064	0.171	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.279	0.279	0.279	0.279
O	0.099	0.066	0.067	0.179	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.292	0.292	0.292	0.292
P	0.089	0.059	0.060	0.162	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.264	0.264	0.264	0.264
Q	0.056	0.037	0.038	0.101	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.165	0.165	0.165	0.165