The Study of Evaluation of the Digital House Price in Taiwan

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Abstract

The electronic technology has been brought to the family houses and makes a profound influence in the building design. Communications within or beyond the house and collecting information from outside have become part of everyday living in the modern family. More construction has built the digital house in their resident project. This research is aimed to study the facilities of digital house and to understand the determinants of digital house price in Taiwan.

Therefore, we use the multi-criteria decision making--AHP (analytic hierarchy process) method to analyze the effecting factors of digital house in Taiwan. We use 16 criteria to measure the determinants of price of digital house in Taiwan. We investigate developers, appraisers and real estate brokers.

Through our research, we found that the security of digital system is the most important factor. The information technology which integrates the computers, information and electronic technology has been brought to the residential house. The digital houses not only make a profound influence in the real estate industry but also in the real estate appraisal.

Keywords：Evaluation, Digital house, Housing Price factors, Analytic Hierarchy Process (AHP)

Introduction

Digital house is also reflected Intelligent Home, Digital home[1], or Technical Home. Traditionally, Digital house is deploying a local area network, and each computer in the local area network can communicate, and access the server. Furthermore, the entire local area network can be linked to the Internet via a phone line. Cisco Company has pointed the concept of the Home2000 which has 3 principal: Intranet (Community Information Network), Extranet (Community Surroundings) and Internet (Community Internet). The intranet includes a community bulletin board, community communication centre, community monitor system, Internet phone system, and video on demand. Extranet links businesses around the neighbourhood to the community network. Internet service allows residents in a community to access to the Internet via a dedicated line to enjoy broadband access. The first digital housing community was located in Hsinchu City. With the success of digital housing built , in the subsequent years, community networks, broadband communities, intelligent home and electronic homes have become a new favouritism of real estate market.
Community networks which are on-demand in a digital house provide broadband networks for community residents. The purpose of community networks access to the Internet system; this community networks type trend is generally a commercial supply thus raising the property value in the community.

There is a so-called “Intelligent Building” framework in United States that comprises telecommunications, office automation, and building management. These communication systems first appeared in the office buildings, when computers be came common, residential buildings added. Building management system provides fireproof, protection against robery, air conditioning, and energy management functions.

The construction companies call digital house, are buildings in which all residents which live in the digital house of community that have the ability to connect to the

[1] According to Pchome magazine, a digital house is defined as a fully automated residence that use computing devices and home appliances that conform to a common standard for internetworking such that are controlled by computer. The digital home has network sockets in every room.

Internet once are turned on, such that resident can enjoy internet services such as phoning, electronic transactions, stock market information, leisure, and entertainment. Such buildings have installed Internet sockets and provide 24-hour, instant high-speed Internet access without the use the Internet Services Provider (ISP) or additional telephone lines. Construction companies are constantly improving bandwidth, and with improvements in software-based services, are allowing expansion into e-commercial trading. All of these benefits increase the standard of living for digital buildings residents.

As equipments of in digital houses buildings differs from than in traditional buildings, many studies have analyzed design content differences between digital house and traditional houses. The Analytic Hierarchy Process (AHP) is commonly used to explore in-depth the factors of digital house prices.

A review of Taiwanese literature related to community networks shows that most studies are case studies (Zhang 1998; Zhan 1999; Peng 2001) or explore digital buildings. Among these studies, most in-depth analysis focuses on content analysis of equipment in digital house. (Lin 1997, Chen 1999, Xu 2000, and Tian 2000). No pattern or model exists for evaluation or explaining the factors that affect buildings price. Wilcox (2002) investigated the web-service offered by government and proposed that intelligent homes will be popular by 2007.

Many researchers previously study using AHP to investigate the effects of environments. These studies generally analyzed the factors that affect the environment. These studies identified factors, such community information security systems, community electronic life circles and community Internet systems. Wu (2000) and Lee (2001) used AHP to investigate the factors influencing communities to develop an integrated Internet. They are lack of studying price of digital houses or digital buildings.

Are digital housing buildings more expensive than traditional residential buildings? According to information for one project in Taipei County, a digital house was NT$6,000–NT$9,000 per square meter more expensive than traditional houses in the same real estate market. Generally speaking, this paper will study factors associated with digital houses prices at first. Secondly, this study analyses the equipment in the traditional residences and digital houses to identify

equipment-based differences as a basis for analyzing the factors that affect the price of a digital house.

Which equipments do digital houses have?

Remember what TV was like before the remote control? Neither do we, but we're guessing it was no fun. The ability to control your TV or even your entire home theatre while lying on the couch has become a way of life. Now imagine being able to control every system and appliance in your home in much the same way--not just from your couch but from every room in your house and even remotely. That's one of functions at digital house.

The concept of home automation is to connect all of these systems and devices so that they can be controlled from anywhere and react to one another. For example, as you arrive home, your home-automation system can automatically turn off the sprinklers, open the garage door, unlock the front door and disable the alarm, light the downstairs, and turn on the TV. If you power on the DVD player, it might automatically dim the lights, draw the shades, and direct all calls to voicemail.

To make this happen, you need a network to tie it all together. Wireless networks are ideal for distributing data, voice (VoIP), and audio video to different parts of the home. But they are overkill if you simply want to tell a lamp to turn itself on. Instead, most homes will have two different connected networks: one for accessing and distributing rich broadband content and the other for managing all of the devices and systems at home. These home-automation networks, by contrast, have low data rates (typically less than 200Kbps), are extremely inexpensive, use very little power, and can reliably controls hundreds and even thousands of devices. There are several different types of management networks as are shown in Table.1 .

Table 1. Internet Function at Home

Home Controls	1. Energy Management
	2. Environment Temperature with Air Conditioning Systems
	3. Environment Sensor System
	4. Uninterruptible Power Supplies (UPS) System

	5. Microbiological Garbage Treatment System 6. Solar Collector 7. Water and Electricity Remote 8. Home Security Automation: The system will automatically report to the service centre with alarm once appeared the warning sign, and start up the related household appliances with emergency status in the meantime. 9. Home Medical and Health Protection: Hospital is able to off-site-consulting to the patients which are using Internet thru networking intelligent sensor. 10. Automatically Maintenance Services: Intelligent self-diagnosis of malfunctions, and self-expanding new functions.
Cultural Cultivation	1. Multimedia Network Entertainments 2. Online Search Information 3. Learning Lessons from Internet 4. Video-Phone 5. Live Video Delivery 6. Online Leisure and Entertainments: Online chat rooms, online games, and online TV etc.
Internet	1. E-Mails 2. World Wide Web 3. Files Transfer 4. Remote Login 5. Live Stock Market Information Service 6. Facsimile Service 7. Online Tutorial
Household Appliances	1. Intelligent Controls: Such as heating time cybernation etc. 2. Interact Intelligent Controls: Via voice recognition technology to achieve intelligent household appliances remote functions. 3. Web-Phone 4. Digital Television 5. Recordable DVD Player 6. Digital Audio 7. Remote Equipments Maintenance Service 8. Video-Phone 9. Automatic Lighting
Security	1. Central Monitoring System 2. Entrance Guard System 3. Disaster Prevention System 4. Burglar-proof System 5. CCTV Web-Monitoring System 6. Card Access 7. Doors and Windows Security
Community Networks	1. Community Information Security 2. Community E-Shopping District 3. Community E-Bulletin Board

4. Community Online Chat Rooms
5. Community Security Prevention and Rescue Systems
6. Community Network Management
7. School Webs
8. Police Bureau Webs
9. Residential Personal E-Mail
10. Community Porn Firewall System
11. Community Website
12. Online Neighborhood Watch

Research Method

This study used a multi-criteria decision model, AHP—a common multi-criteria method developed by Saaty (1980)—to analyze the determinants of price of digital house. We surveyed developers, appraiser and brokers. The AHP is a flexible instrument for analyzing complex decisions using qualitative and quantitative criteria for investment decisions. This method requires sequential weighting of a large number of pair-wise comparisons of criteria. The hierarchy structure was used 16 criteria to establish(Table 2) . There were 85 resopndents to be surveyed in 2006. Those resopndents were managers of developer, appraisers and brokers.

Table 2. The Impacting Factors of the Prices of Digital House

Focus	Evaluation Items	Impacting Factors
	Community Digital Communication	Community Network Server Device
		Broadband Connection Installations (ADSL, CABLE or ISP)
		Fibre Cable Device
		Community Wireless Network
		Community Website System
	Community Digital Security System	Community Security & Monitoring System Devices
		Home Security & Monitoring Systems Devices
		Home Gateway/ Residential Gateway
	Digital Life Equipments	Home Interaction Intelligent Controls
		Digital house Appliances (Information Appliances)
		Multimedia Home Entertainments Network Systems
	Energy Technology Systems	Community Water Cycle System
		Community Environment Sensor System
		Community Solar Energy, Light & Electricity Devices
		City Wireless Network

The Geometric Average Method is applied as an integrated function to questionnaires to examine investigation results using the Consistency Index (C.I.) and Consistency Rate (C.R.), both of which were smaller than the general tolerable level (C.R. <0.1). The Consistency Index of the Overall Index was 0.0414 with Consistency Rate of 0.0562, which is 0.1 smaller than the Consistency Rate reccomended by Saaty. Thus, comparative weights are reasonable (Table 3)

Table 3. The consistency results in the survey

the consistency ratio		
examining the uniformity of all factors	CI	0.0798
	CR	0.0712
examining the uniformity of hierarchy structure	CI	0.0414
	CR	0.0562

Empirical Results

Investigation and interview results show that respondents were primarily from southern Taiwan, which accounted for 95% of all respondents. The years in business were over 21 years for 32% of respondents, and less 5 years for 26%. Business turnover was mostly over NT$10(US$ 0.3) billions. In addition, the occupation of respondents are majority brokers.

Analysis of Factors Impacting Digital House Prices

1-1. First Hierarchy Results

Overall Index evaluates the impacts on digital house prices by community digital security systems, community digital telecommunications, home digital devices, energy technology systems, and external digital environment; from Table 4, the results show no matter the evaluations of the prices are high or low of digital house communities, the most prior concerning factor is the community digital telecommunications and its weight value is 27.53%, secondly is community digital security system which is 24.87%, and then digital Life equipments take 19.32%.

Table 4. Impact Factors on the Price of Digital Houses

Primary factors-Evaluation Items	Weight (%)	Priority
Community Digital communication	27.53%	1
Community Digital Security System	24.87%	2
Digital Life Equipments	19.32%	3
Energy Technology Systems	14.79%	4
External Digital Environment	13.50%	5

From analyzed the above information, we found that the major concern is still based on whether a traditional community is secured or not when appraising the prices of digital house community; therefore, while constructs the digital house devices are still relaying on the measurement index of whether it provides digital security devices systems or not.

1-2. Second Hierarchy Results

According to the second hierarchy observation results (Table 5), the major impacts are broadband networking devices and fibre cable equipment with weights of 22.76% and 22.66%, respectively.

Table 5. Factors affecting digital house prices in the community digital communication

Priority / Factors	Weight (%)	Priority
Broadband Connection Installations (ADSL, CABLE or ISP)	22.76%	1
Fibre Cable Device	22.66%	2
Community Network Server Device	20.36%	3
Community Wireless Network	19.11%	4
Community Website System	15.46%	5

The majority factors impacting community digital security systems is digital equipment for monoitoring residential security (40.41%). The second factor is community security equipment (38.27%); the combined total for both factors is roughly 80%, indicating that the price of a digital house mainly depends on digital security equipment quality, and may affect the response of the priority examining factors of the domain of security and is what most people pay for when purchasing a digital house (Table 6).

Table6. Factors for Prices of Digital House in the Community Digital Security System

Priority / Factors	Weight (%)	Priority
Home Security & Monitoring Systems Devices	40.41%	1
Community Security & Monitoring System Devices	38.27%	2
Home Gateway/ Residential Gateway	21.32%	3

In the past very few studies have discussed the factors affecting digital equipment prices. This investigation determined that most specialists and academics believe that digital control devices have the most impact on residents, accounting for around 38.76% of home interaction intelligent controls. (Table 7) Second was Intelligent Appliances (38.27%)—Intelligent Appliances are home appliance products, such as digital televisions, networking refrigerators, networking washing machines, and networking microwaves, that can connect to the Internet. According to respondents, such appliances were mostly individual equipment in

the past; however, these applicances will be connected to networks in the future to save energy.

By the peopole familiarization of networks, digital equipment may attain the target of saving energy, thus, by combining the functions of a network with energy savings, this study analyzes the energy-saving characteristics of digital appliances. This investigation found that the impact of energy-saving technologies on price is small. That is, most respondents were unconcerned with energy-saving issues (Table 4). However, in discussing the relationship between energy-saving technology, networks and community, most respondents believed that the water cycle systems have a large effect on price.

Table7. Factors for the prices of digital house in the Digital Life Equipments

Priority / Factors	Weight (%)	Priority
Home Interaction Intelligent Controls	38.76	1
Digital house Appliances (Information Appliances)	32.08	2
Multimedia Home Entertainments Network Systems	29.15	3

Table8. Factors for the prices of digital house in the Energy Technology Systems

Priority / Factors	Weight (%)	Priority
Community Water Cycle System	40.00%	1
Community Solar Energy, Light & Electricity Devices	34.17%	2
Community Environment Sensor System	25.85%	3

Table9. Factors for the prices of digital house in the External Digital Environment

Priority / Factors	Weight (%)	Priority
City Information System	53.71%	1
City Wireless Network	46.29%	2

From the impact factors on the prices of external digital environment, that the respondents think the difference between city information system and city wireless system is very small, in other words, the impacts on price of the external digital environment is smaller; most respondents believe that the impact factors of

price is interior instead of external. This may relate with the major concerned factors of purchasing house mainly on interior facilities.

1-3. the Composite Evaluating Prices of Impacting Factors of Digital House

This study evaluates all factors impacting the digital housing, and found that the security monitoring system and community were most important factors with weighted value of 11.12% and 10.54% respectively. The security system is the primary concern of buyers. The second concern is intelligent control systems (7.49%); the advantages and disadvantages of digital equipment were less marked (Table 10).

Table10、Composite Evaluated Factors of the Prices of Digital House

Priority / Factors	Weight (%)	Priority
Home Security & Monitoring Systems Devices	11.12%	1
Community Security & Monitoring System Devices	10.54%	2
Home Interaction Intelligent Controls	7.49%	3
City Information System	7.25%	4
City Wireless Network	6.25%	5
Digital house Appliances (Information Appliances)	6.20%	6
Community Water Cycle System	5.92%	7
Home Gateway/ Residential Gateway	5.87%	8
Broadband Connection Installations (ADSL, CABLE or ISP)	5.66%	9
Fibre Cable Device	5.64%	10
Multimedia Home Entertainments Network Systems	5.63%	11
Community Network Server Device	5.06%	12
Community Solar Energy, Light & Electricity Devices	5.05%	13
Community Wireless Network	4.75%	14
Community Website System	3.84%	15
Community Environment Sensor System	3.82%	16

Conclusion and Suggestions

Conclusion

Digital houses are the newest type of residential buildings. Bill Gates spent almost US$97 million on a digital house that is completely controlled by a computer. Lighting, air conditioning, audio, security and resident monitoring are all controlled through touch screens. Thus, house systems can be easily controlled. Additionally, meetings with dealers can be held via video telephone. When out of the house, Gates can control house systems via a PDA.

Generally people may not plan on spending a lot of money on digital devices at home like Bill Gates, but it is common to find digital equipment pre installed in a digital house, fibre optic cable is likely becoming the basis for most equipment interfacing; the newly building now is fibre to the internal building, which is also called FTTB; and now even advancing to the extent of fibre to the home (FTTH).

This research mainly treats the influences of evaluating price with digital house equipment, most respondents understand this issue is a disposition to the formulation of community security equipments, which is still quite different from the digital house of what Cisco presented, conceptions of Home2000 or what technical businesses expected. So far what digital house called by real estate market is just on the stepping stage, therefore you can only call it an “Automation” home or “Security Equipment Home” as it hasn’t been fully integrated to the functions that what a should have.

In consequence of this process, of multi-level analysis that impact on the digital house community the price is still decided on the impact factors of, community digital security systems, secondly community digital telecommunication equipment, and thirdly home digital equipment.

Although people may not plan to spend a lot of money on digital devices, it is common to find digital equipment installed in a digital house. Fiber-optic cable is becoming common for most equipment interfacing. New buildings now use fibe-optic cable to the internal which is also called fiber to the building, and is advancing to fiber to the home.

This research evaluated the price of houses that have digital equipment. Most respondents do not understand this issue clearly. They mostly thought that digital house is a disposition to the formulation of community security equipments, which

is still markedly different from the digital house developed by Cisco, conceptions of the Home2000 or what technical businesses expect. So far, the digital house is just beginning to be favored by buyers. Therefore, such homes can only be called an “Automated” home or “Security Equipment Home”. The multi-level analysis indicated that price is based on digital security systems, community digital telecommunication equipment, and home digital equipment.

Suggestions

2-1. Promote Digital Houses, and Implement Digital Equipment use

Building a digital house should encompass the establishment of software and hardware devices, that can transform one’s lifestyle and significantly change daily living. Although a high demand exists for digital houses, potential buyers may noy be cognizant of all a digital house can offer. Therefore, a completely digital house can be used for education. Most respondents expressed that they were not quite sure what a digital house was. After a detailed explanation, they gained a an understanding. The quastion as to whether buyers are willing to pay for a digital house remains.

2-2. A digital house community should be designed with Interior and external environment at the Same Time

A digital house requires an interior network, broadband Internet access, multi-wirings and smart appliance connected to the network. When designing a digital house interior network, digital house server dedicated space, Internet-dedicated wiring, and Internet information for digital equipment, buyers seem to ignore the co-ordination of internal and external environments.

2-3. Appraisers need to learn the equipments of digital housing price on the ppraisal Works

Traditionally, when appraisers evaluate house price, they focus on major three factor categories: general factors, regional factors and individual factors of a house. Appraisers also evaluate constructional factors. When ncreasing number of digital buildings on the market, the appraisers nedd to be pay more attention on the digital equipment and digital content on their appraisal work.

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