ปัจจัยที่มีผลต่อความพึงพอใจในโฟโตบุกของเยาวชนไทย

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FACTORS AFFECTING PHOTOBOOK PREFERENCES OF YOUNG THAI

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Department of Imaging and Printing Technology

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นคร ชิงห์ : ปัจจัยที่มีผลต่อความพึงพอใจในโฟโตบุกของเยาวชนไทย.(FACTORS AFFECTING PHOTOBOOK PREFERENCES OF YOUNG THAI) อ.ที่ปรึกษาวิทยานิพนธ์หลัก : รศ.ดร.อรัญ หาญสืบสาย, อ.ที่ปรึกษาวิทยานิพนธ์ร่วม: ศ.ดร. เท็ตซึยะ ซาโตะ, 67 หน้า

งานวิจัยนี้ศึกษาหาปัจจัยที่มีผลต่อความพึงพอใจโฟโตบุกหรือหนังสือภาพของเยาวชนไทย และหาพารามิเตอร์ต่าง ๆ ของคุณภาพสิ่งพิมพ์ที่มีเกี่ยวข้องกับการรับรู้ของผู้บริโภค การทดลองใช้แบบสอบถามสัมภาษณ์นิสิตนักศึกษา อายุระหว่าง 17- 24 ปี เพื่อต้องการทราบว่า มีปัจจัยใดบ้างที่มีส่วนช่วยในการตัดสินใจในการสั่งทำหนังสือภาพ กลุ่มคนที่เลือกมาสัมภาษณ์นี้ถือว่าเป็นตัวแทนของเยาวชนไทยหนุ่มสาวที่ส่วนใหญ่ใช้เวลาว่างกับกิจกรรมผ่านเทคโนโลยีสารสนเทศ ผลการวิเคราะห์ทางสถิติด้วยวิธีเฉลี่ยเลขคณิตถ่วงน้ำหนัก พบว่า คุณภาพสิ่งพิมพ์และการออกแบบโฟโตบุกเป็นปัจจัยในอันดับต้น ๆ ที่มีผลต่อการตัดสินใจในการทำโฟโตบุก นอกจากนี้ยังให้ผู้สังเกต ทำการประเมินและจัดลำดับพารามิเตอร์คุณภาพของภาพพิมพ์ที่ทำมาจากโรงพิมพ์ 5 แห่ง ด้วยเครื่องพิมพ์ต่าง ๆ กัน ในระดับไฮ-เอน นำข้อมูลการสำรวจไปทำการวิเคราะห์ทางสถิติด้วยวิธีการจัดลำดับเชิงวิเคราะห์(Analysis Hierarchy Process) ซึ่งมีค่าระหว่าง 0 ถึง 1 นำไปสร้างสมการความพึงพอใจของเยาวชนไทยต่อคุณภาพของภาพพิมพ์พบว่า ผลของค่าที่คำนวณได้สามารถทำนายผลของลำดับการประเมินจริงของกลุ่มผู้ทำการประเมิน

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This research attempted to find out which factors affecting photobook preferences of young Thai and to understand how the print quality parameters affected perceived image of photobook and how this perception changed as a function of a Thai customers' preference. A group of participants, 17-24 years old, were asked to express their feelings about photobook products and to indicate the acceptability of factors, which influence the decision to make photobook. These participants represented the young Thai whose hobbies are mostly related to IT (information technology). Results based on weighted arithmetic Mean showed that print quality of printed images and design of photobook were the prior factors affecting the preference of these people. In addition, individuals viewed and provided rating information of quality parameters of print samples made from 5 print shops with varying high-end printers. The survey data were analyzed by Analysis Hierarchy Process (AHP) technique, by which loading factors, ranging 0-1, relevant to young Thai' preference regarding print quality parameters were obtained. Print quality preference equation thus could be established. Results showed that the preference equation could predict the preference of the young Thai by observation.

Department : Imaging and Printing Technology Student's Signature .....

Field of Study : Imaging technology Advisor's Signature .....

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CHAPTER I

INTRODUCTION

1.1 Scientific Rationale

Since the first photos was originated in 1826, photographic industry has been gradually developed [1]. Throughout the time from the original, a lot of story from the history was recorded by photographer into small papers such as a postcard size. Before 2000, business about printing shop was very popular. However, time change everything, the digital age was coming and altered the customer behavior. Photos was not only on a papers but also on a computer storage devices. Digital camera including camera phones permit users to capture a lot of photos every day, however they would not like to print photos at a shop as a previous day. Photobook is a new innovation. It not only helps the printing business, but also let customers manage and storage a lot of pictures.

Photobook is a book containing pictures to present a series of images for special occasions and everyday memories such as wedding, graduation, traveling and family. It is adopted by consumers to organize photograph with text into pages. Creating a photo book rather than a stack of loose prints diminishes the risk of accidentally losing or destroying images.[2] To make photobook, pictures are processed through a design programs downloading from provider, they let users manually customize the photobook by themselves and sent it to print by internet.

In the United States, the market value of photobook had increased gradually from 44 million of dollars to 326 million of dollars between 2004 to 2008.[3] In the same way the Western Europe photobook market was valued at 170 million of euros growing to 370 million of euros between 2006 to 2008.[4] In case of Thailand, the photobook was first introduced about 7 years ago. Nowadays there are many photobook providers in Bangkok, but factors about photobook such as size, price, material, design and others do not have standards in the same way including printing parameters.

1.2 Objectives of Research Work

1.To survey factors affecting to the decision of young Thai to make photobooks
2.To find out print quality parameters involving perceived image of photobooks
3.To establish preference equation of Thai people on print quality of photobook in Thailand

1.3 Scope of the Research Work

This research focuses on the factors affecting the preference of young Thai on photobook. It was divided into three parts. In each part has a questionnaire. It was on Chulalongkorn University students but all questionnaires were on different student groups. The first part surveyed the factors affecting the decision of young Thai to make a photobook. The result of first part was used to design the other two parts. Part two and three was on the same time. The second part analyzed the obtained data from samples by using Analysis Hierarchy Process (AHP) method, by which loading factors, ranging 0-1, relevant to young Thais' preference regarding print quality parameters were obtained. Print quality preference equation thus could be established. The last part was to find out the print quality parameters involving the perceived image photobook. Print samples were obtained from five well known photobook service providers in Bangkok. 153 students, ranging 17-24 years old, were involved in these research as observers.

1.4 Expected Outcomes

1. The factors affecting the decision of young Thai to make a photobook
2. The preference equation of Thai people on print quality of photobook in Thailand

1.5 Contents of the Research Work

Chapter 2 consists of theoretical background and literature reviews that relate to this research. Chapter 3 gives details of experimental design as follows: questionnaire information, survey factors of Thai preference on photobook, using combination arithmetic mean method, ranking print samples from 5 printers based on their quality, analysis the print quality parameters data obtained from 5 print samples using AHP method. Chapter 4 is results and discussion. Chapter 5 gives conclusions and suggestion for future work.

CHAPTER II

THEORETICAL BACKGROUND AND LITERATURE REVIEWS

2.1 Theoretical Backgroud

2.1.1 Photobook History

A photobook is a book where the work's primary message is carried by photographs. It is a book authored by a photographer or by someone editing and sequencing the work of a photographer, or even a number of photographers. It has a specific character, distinct from the photographic print, be it the simply functional "work" print, or the fine-art "exhibition" print.

From the very beginning in the nineteenth century original prints were pasted in to books by hand, for example, William Henry Fox Talbot's book *The pencil of Nature*, published as a past-work between 1844 and 1846, although from the start, the search was on for a way in which to print photographs in ink. It was only after the development of the halftone printing block that photo-publishing could be made available to a true mass market. In the 1920s and 1930s particularly, the photobook became an essential tool of the documentary movements in the United States, Western Europe and Soviet Union, to be used for the purposes of information or propagenda.[5]

In previous days, the photobook had to be published in the mass product because of the costs of publishing with conventional printing. It had cost-effectiveness in high volume jobs to propagate the information such as works, idea, profile, history, art and many others, But the photobook today is easily to produce than the former days because of digital printing technology. It provides lower per unit costs for very small print runs. It permits general customers to create a single copy of photobook.

Digital printing presses had been designed in 1989 however it began being used in 1991, in that time the printing was difficult to operate and maintain. The evolution

of digital printing was somewhat complicated, but Xerox played a large role. About ten years after that day, Personal photobook was emerged.

Personal photobooks were a popular means of capturing important moments and people have ever created this kind of multimedia presentations. With the advent of photography and internet network, it is now possible to digitally design a photobook on a home computer and let it be printed by commercial print providers such as photofinishers and quick print shops.

Many photofinishers and quick print shops enable their customers to design digital photobooks on a home PC and let them be printed in a high quality manner. In Thailand several photobook providers have taken this step even further and not only provide customers with a handy tool to do the actual design process but also relieve them from several tedious and time-consuming tasks likes sorting and selecting of photos. These enhanced functionalities are realized with the help of outcomes of several research activities [6][7].

2008 PMA photobook report notified that the market values of photobook in U.S. gradually rose from 44 million of dollars in 2004 to 267 million of dollars in 2007.[8] *InfoTrends' 2011 Western European Photo Merchandise Forecast* indicates that sales of photo merchandise in Western Europe will climb from 161 million units in 2011 to nearly 250 million units in 2015.[9] *Lyra Research's latest report, The 2011 Consumer Photo Book Market* estimates that by 2014, worldwide gross profits from photo books will reach one-third the profits from photo prints.[10]

The photobook in Thailand was first introduced by Image Quality lab co,Ltd in 2006. It has intrigued young Thai people [11]. Nowadays there are many photobook shops all around country.

2.1.2 Phases of Photobook Production

The process of photobook production is classified into 4 phases -capture, author, print and bindery.

2.1.2.1 The capturing phase

It deals with all steps that are prerequisites for authoring a photoook and happen before actually working with the photobook software. The processes are not of the photobook authoring system, but their outcomes are directly fed into the authoring process. Usually photos are related to various preliminary decisions and circumstances, which are input to planning process, for example the planning of a holiday trip, which is done by one or more persons. In addition, some information of plan or schedule, e.g. a travel schedule or the detail for a visit can be important for the later authoring process.

The process of taking a photo itself is an instance of a capturing process. It seems to be involved by the decision of photographers to press the release-button which is input to the photo capturing process. This of course affect the design of a photobook in the authoring phase.

2.1.2.2 The authoring phase

It involves the software management to design photobook and page layout. First the user selects in a wizard which photos should be taken as input for the photobook. These photos are input to the selection of a subset which are subject to appear in the photobook. Here blurred images or images with poor quality should not be chosen and if the images having bright colors should be preferred. The other constraint is the amount of images which should appear in the photobook. For this, the user can state the approximate number of photos per page and how many pages in the photobook should consist of. For the page layout process, it automatically arranges the photos over the pages and defines appropriate background for the photobook pages. The parameters are user preferences which are asked from the user within the wizard

process. Some of these parameters, like the style of page layouts or which kind of backgrounds should be chosen. Other medications are cropping, re-sizing, moving or rotating of photos in the photobook. Thus, it can be said that making a photobook means facing many decisions that have to be made. There are lots of details that are just right. It's very likely that every detail is the result of someone thinking carefully about that detail and then making a decision. People normally start thinking about size and production details. But first and foremost, some start thinking about photographs and how to translate the images into the book such as the edit, the sequence, and the design[12].

2.1.2.3 The Printing Process

It is an instance of a publish process in which the layout information is transformed into a physical product. It is important that the quality of printed images should be considered. Nowaday, digital printing becomes an effective tool to produce printed images. Its quality has steadily improved from early color and black and white copiers to sophisticated hi-end color digital presses such as the Xerox iGen3, the Kodak Nexpress, the HP Indigo Digital Press series, and the InfoPrint 5000. The iGen3 and Nexpress use toner particles and the Indigo uses liquid ink. The InfoPrint 5000 is a full-color, continuous forms inkjet drop-on-demand printing system. All handle variable data, and rival offset in quality. Digital offset presses are also called direct imaging presses, although these presses can receive computer files and automatically turn them into print-ready plates, they cannot insert variable data.

2.1.2.4 Bindery

It is the last phase involving how to collage printed pages together including finishing and binding techniques. These binding techniques are stitching, wiring, glue binding and sewn book. Hard cover is included. Decoration of cover is necessary for attractive and value-added.

Accordingly, as mentioned above, there are many factors based on the creation of photobook which affects the satisfaction of users or customers. For example:

- book size
- page layout design
- color design
- printing paper types: uncoated/coated, gloss/matt surfaces, low/high grammage
- binding technique: soft/hard cover, material types
- cover type and decoration

Most of photobook shop offers five different sizes for photo book: 5X7, 7X9, 8X11, 8X8 and 12X12. For page design, some softwares have choices for users to choose relating occasions like New year, mother's day, graduation, including baby or wedding, and interests, such as sports or travel.

2.1.3 Digital Printing

Digital printing is one of printing technique using digital based data directly to a variety of media. It usually refers to professional printing where short-run jobs from desktop publishing and other digital sources are printed using large format and/or high volume laser or inkjet printers. It also allows for on-demand printing, short turn around, and even a modification of the image (variable data) with each impression. The savings in labor and ever increasing capability of digital presses means digital printing is reaching a point where it could match or supersede offset printing technology's ability to produce larger print runs of several thousand sheets at a low price.

Digital printing technology has grown significantly over the past few years with substantial developments in quality and sheet sizes. It has many advantages over conventional methods. Applications include:

- Desktop publishing – inexpensive home and office printing
- Variable data printing – database-driven print files for the personalization of printed materials
- Fine art – archival digital printing methods on special papers
- Print on Demand – for example, children's books customized with a child's name, photo books (such as wedding photobooks), or any other short run books of varying page quantities and binding techniques
- Advertising – outdoor banner advertising and signage, including retail sector at point of sale or point of purchase, and in personalized direct mail campaigns
- Photos – photo printing in terms of the ability to retouch and color management before printing

2.1.4 Print Quality Parameters

Print quality is one of the prime factors that influence the decision of photobook making. Theoretically, we can categorize print quality parameters as followings:

- Contrast
- Resolution
- Tone reproduction
- Color matching
- Sharpness

2.1.4.1 Contrast

Contrast is the range of reflectance density difference between high light and shadow areas of a print [13]. This parameter is used to evaluate the optimization of the density of the ink deposited on the substrate during printing. The ink strength or contrast is determined to take into account the solid ink density, the density of the ink in shadow and high light areas of the image. It is calculated according to the formula

$$C = D_s - D_h \quad \text{.....(2.1)}$$

where D_s is the shadow area density, and D_h is the high light area density.

2.1.4.2 Resolution

The term “Image resolution” means how many of image’s pixels will fit inside each inch of paper when printed. The higher the resolution, the crisper and more detail of image will be. A lower resolution will be fuzzy and less detail. Generally, dots per inch (dpi) of a printer is a measure of spatial printing, in particular the number of individual dots that can be placed in a line within the span of 1 inch (2.54 cm). In addition, the more dpi, the smoother is the tonal gradation in the print, the finer the definition and the wider the color gamut. However, it should be note that the dpi value tends to correlate with image resolution, but is related only indirectly. Like print sharpness, It is affected directly by the image editing software. The only way to determine print resolution capability, which includes the effects of software, ink and paper, is to make test prints over a practical range of magnifications. Line resolution test form, consisting 0.1 – 0.5 mm is designed. The finest line which could be reproduced will be examined.

Figure 2.1 Resolution target

2.1.4.3 Tone reproduction

Tone reproduction is that print quality attribute represented by the lightness dimension of color space. We say that a reproduction has good tonal qualities when the

overall contrast and perceptual separation between lightness values throughout the tone scale appears similar to the observer's preferred memory of the original scene. Good tone reproduction equates to good tonal separation in shadows, highlights, or other areas of the tone scale that are important to the viewer. [14].

Tone reproduction is considered as the appearance of a printed output compared with the input data relating to optical density or luminance value or tone value (% dot area). Dot-based printing methods have a finite native dot size. These dots represent each separated color CMYK and overlap their neighbors to some extent. They could be larger or smaller than those of the target aim. Normally, a tone reproduction curve is applied for representation of this parameter. Gamma of the curve, thus, will be useful to evaluate the tone reproduction of printed image, as the concept of gamma can be applied to any nonlinear relationship. It can be visualized as the slope of the input–output curve.

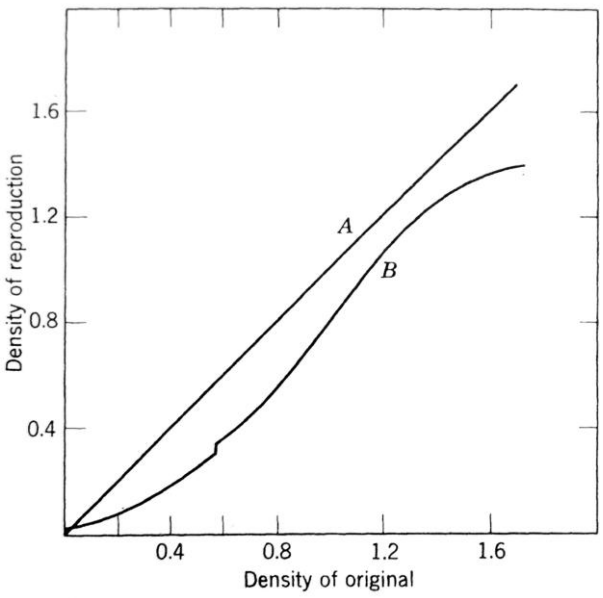

Figure 2.2 Comparison of a tone reproduction print (curve *B*) with the ideal tone-reproduction (curve *A*)

In a facsimile reproduction, If the density of reproduction plotted against the density of original, a 45° straight line would be obtained, but, in practice, there is a loss

of high light and shadow contrast, whereas there is too much contrast at middle tones. In halftone processes a “jump” often occurs at a density of about 0.3 because of dots join up as shown in Figure 2.2[15].

2.1.4.4 Color matching

Color matching is the process of assuring that a color on one medium remains the same when converted to another. ΔE is a measurement used to indicate how much a color deviates from an accepted standard. The higher the ΔE, the more inaccurate the color. ΔE of zero is a perfect because of no different from original, but in practice it is not necessary to zero. The human eye is only capable of detecting color difference at certain thresholds. 1 ΔE was a minimal detectable difference. The ISO printing standard permits ΔE up to 5. Figure 2.3 show the perceptible difference of color on 1931 CIEXYZ Chromaticity Diagram model.

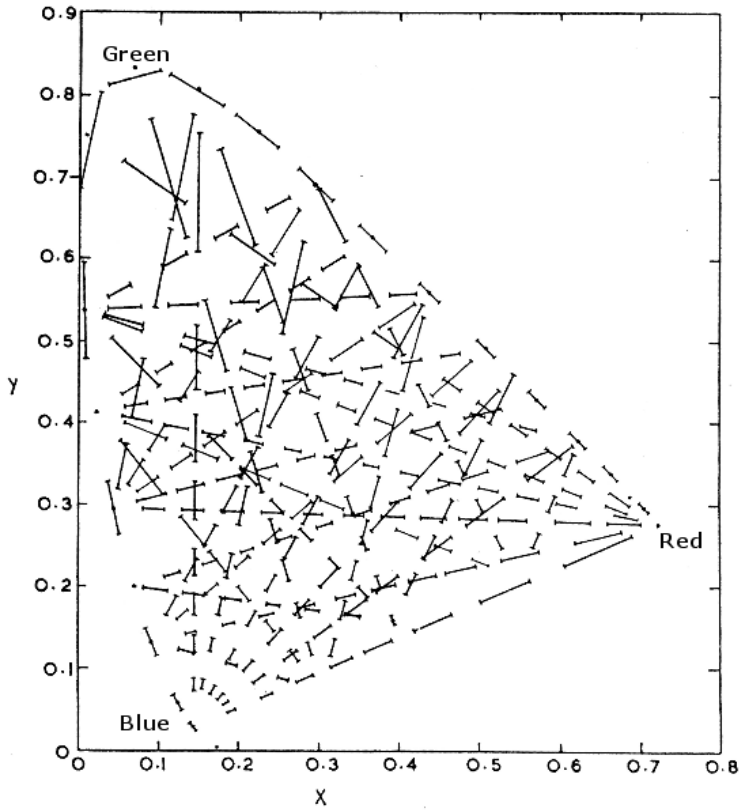

Figure 2.3 CIEXYZ Chromaticity Diagram

Because the CIEXYZ Chromaticity Diagram (Figure 2.3) from 1931 was less the ability of a color appearance model to plot changes in color that accurately represent what we actually see , In 1976 the CIE(Commission International De L'Eclairage or International Commission on Illumination) recommended two new color appearance models that were significantly more perceptually uniform than the old standard. These were CIELUV and CIELAB (Figures 2.4-2.5), ΔE came into widespread since that time.

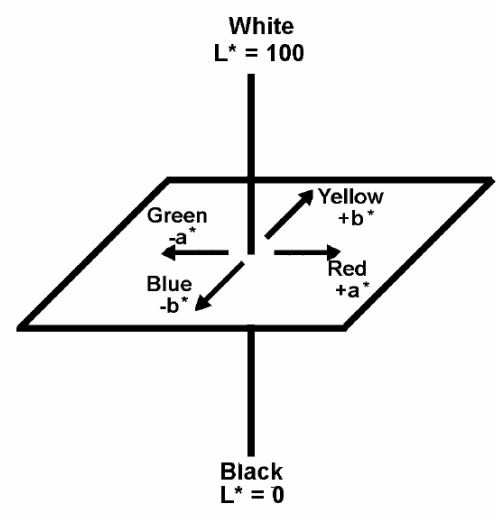

Figure 2.4 CIELAB coordinate system

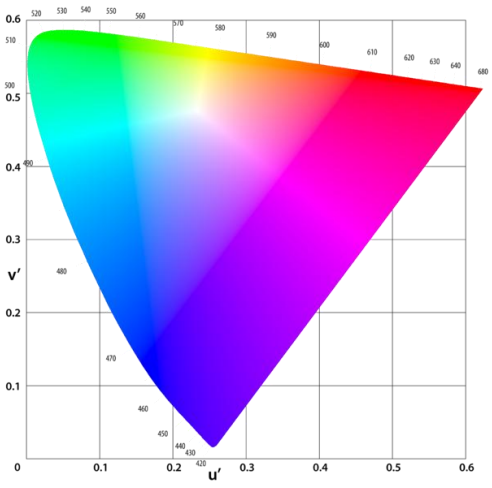

Figure 2.5 CIELUV coordinate system

Although the both models were equivalent in accuracy, but CIELAB was more the favored model. However, something was lacked in CIELAB, CIELUV has it. The CIE offered both standards as something of a compromise. These models also included a formula for calculating color differences known as ΔE76 [16]

Using (L_1^*, a_1^*, b_1^*) and (L_2^*, a_2^*, b_2^*) to be two colors in CIELAB space, the delta E has a Equation below

$$\Delta E_{ab} = \sqrt{(L^*{}_2 - L^*{}_1)^2 + (a^*{}_2 - a^*{}_1)^2 + (b^*{}_2 - b^*{}_1)^2} \quad \text{.....(2.2)}$$

2.1.4.5 Sharpness

Perceived sharpness depends on print size, viewing distance and viewer expectation. The level of satisfaction is affected by the image editing software, which processes the pixels before sending them to the printer. It resamples the image using interpolation technique before sending it to the printer. In addition, ink spreading could affect this parameter when applied to paper, and it spreads differently on different papers (glossy tends to be sharper than matte). Printer software is designed to compensate for the overall tonal effects of ink spreading, but it doesn't affect resolution.

Studies on human visual acuity suggest that the smallest feature that an eye can distinguish on an 8x10 inch print at 10 inches is more like 0.003 inches. At the depth of field limit, sharpness is only *one third* of what the eye can distinguish.

Device or system sharpness is measured as a Modulation Transfer Function (MTF), also called Spatial Frequency Response(SFR). The 50 percent MTF frequency(f_{50}) correlates well with perceived sharpness. It have two ways to get MTF, the first is using Log frequency of sine wave or bar pattern, the second is using slanted edge, however it this paper only slanted edge method was applied to measurement[17].

The slanted edge method to calculate MTF which is derived from images of edges (Spread Function Methods). For a linear photographic system the modulation transfer function is equal to the modulus of the Fourier transform of the line spread function, then the equation of MTF is

$$M(\omega) = \left| \int_{-\infty}^{+\infty} l(x) e^{-2\pi i \omega x} \, dx \right| \quad \text{.....(2.3)}$$

The line spread function is usually obtained by scanning the image of an edge trace which is converted from density to effective exposure using the macroscopic response curve. Differentiation then gives the line spread function, and the whole scheme is illustrated in Figure 2.6. However, Fourier transformation is a simple operation if a computer is available, and one of the advantages of the edge-trace method is that it is readily adaptable to digital recording and data processing.

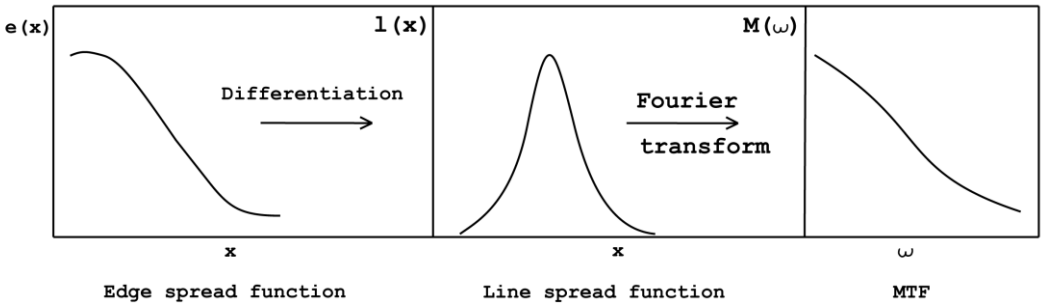

Figure 2.6 Derivation of the MTF from the edge response curve

However, this method, the sampling that exact vertical, horizontal and 45 degrees angle should be avoided because of sampling phase sensitivity. Then, using only slanted edge, this method calculates MTF by finding the average edge derived from a distribution of sampling phases. Slanted edge (Figure 2.8) may select from ISO12233 chart(Figure 2.7) as the sampling[18].

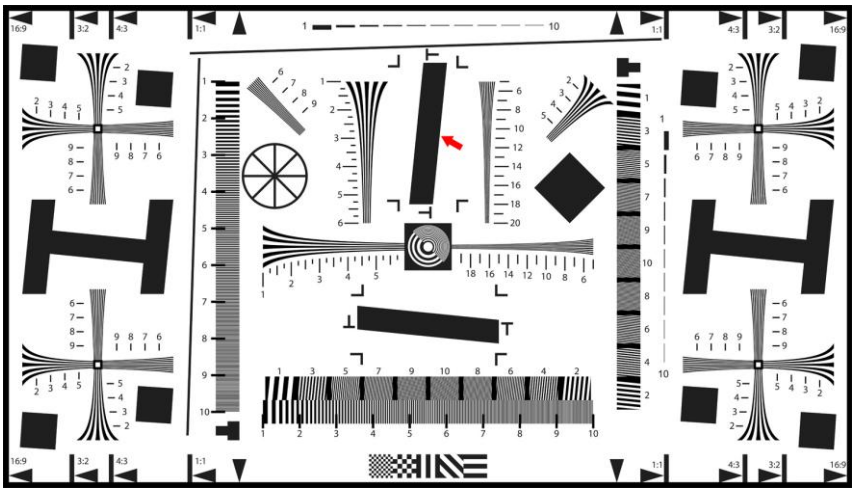

Figure 2.7 ISO 12233 chart

Figure 2.8 Slanted edge selected from ISO 12233 chart

2.1.5 The Analytic Hierarchy Process (AHP)

Analytic Hierarchy Process (AHP) is a structured technique for organizing and analyzing complex decisions. Based on mathematics and psychology, it was developed by Thomas L. Saaty in the 1970s and has been extensively studied and refined since then. Rather than prescribing a "correct" decision, the AHP helps decision makers find one that best suits their goal and their understanding of the problem. It provides a comprehensive and rational framework for structuring a decision problem, for representing and quantifying its elements, for relating those elements to overall goals, and for evaluating alternative solutions

Method

The AHP can be implemented in three simple consecutive steps:

a) Computing the vector of criteria weights.
b) Computing the matrix of option scores.
c) Ranking the options.

Each step will be described in detail in the following. It is assumed that m evaluation criteria are considered, and n options are to be evaluated. A useful technique for checking the reliability of the results will be also introduced.

a) Computing the vector of criteria weights.

In order to compute the weights for the different criteria, the AHP starts creating a pairwise comparison matrix **A**. The matrix **A** is a $m \times m$ real matrix, where m is the number of evaluation criteria considered. Each entry a_{jk} of the matrix **A** represents1 the importance of the j_{th} criterion relative to the k_{th} criterion. If $a_{jk} > 1$, then the j_{th} criterion is more important than the k_{th} criterion, while if $a_{jk} < 1$, then the j_{th} criterion is less important than the k_{th} criterion. If two criteria have the same importance, then the entry a_{jk} is 1. The entries a_{jk} and a_{kj} satisfy the following constraint:

$$a_{jk} \cdot a_{kj} = 1 \qquad \text{.....(2.4)}$$

Obviously, $a_{jj} = 1$ for all j. To make comparisons, the scale is needed to indicates how many times more important or dominant, one element is over another element with respect to the criterion or property with respect to which they are compared. The relative importance between two criteria is measured according to a numerical scale from 1 to 9, The number scale from 1 to 9 is suitable because Observer can judge finely, as shown in Table 2.1, where it is assumed that the j_{th} criterion is equally or more important than the k_{th} criterion. The phrases in the “Interpretation” column of Table 1 are only suggestive, and may be used to translate the decision maker’s qualitative evaluations of the relative importance between two criteria into

numbers. It is also possible to assign intermediate values which do not correspond to a precise interpretation. The values in the matrix **A** are by construction pairwise consistent. On the other hand, the ratings may in general show slight inconsistencies. However these do not cause serious difficulties for the AHP.

Table 2.1 Relative scores of AHP methodology

Value of a_{jk}	Definition	Description
1	Equal importance	*j* and *k* are equally important
3	Weak importance of *j* over *k*	Experience and Judgement slightly favour *j* over *k*
5	Essential or strong importance	Experience and Judgement strongly favour *j* over *k*
7	Demonstrated importance	*j* is very strongly favoured over *k*
9	Absolute importance	The evidence favouring *j* over *k* is of the highest possible order of affirmation
2, 4, 6, 8	Intermediate	When compromise is needed, values between two adjacent judgements are used
Reciprocals of the above judgements	If *j* has one of the above judgements assigned to it when compared with *k*, then *k* has the reciprocal value when compared with *j*	A reasonable assumption

Once the matrix **A** is built, it is possible to derive from **A** the *normalized pairwise comparison matrix* $\mathbf{A}_{norm}$ by making equal to 1 the sum of the entries on each column, i.e. each entry $\bar{a}_{jk}$ of the matrix $\mathbf{A}_{norm}$ is computed as

$$\bar{a}_{jk} = \frac{a_{jk}}{\sum_{l=1}^{m} a_{lk}} \quad \text{.....(2.5)}$$

Finally, the *criteria weight vector* $\boldsymbol{w}$ (that is an *m*-dimensional column vector) is built by averaging the entries on each row of $\mathbf{A}_{norm}$, i.e.

$$w_j = \frac{\sum_{l=1}^{m} \bar{a}_{jl}}{m} \quad \text{.....(2.6)}$$

b) Computing the matrix of option scores

The matrix of option scores is a *n×m* real matrix **S**. Each entry s_{ij} of **S** represents the score of the *i*th option with respect to the *j*th criterion. In order to derive such scores, a *pairwise comparison matrix* $\mathbf{B}^{(j)}$ is first built for each of the *m* criteria, *j=1,...,m*. The matrix $\mathbf{B}^{(j)}$ is a *n×n* real matrix, where *n* is the number of options evaluated. Each entry $b_{ih}^{(j)}$ of the matrix $\mathbf{B}^{(j)}$ represents the evaluation of the *i*th option compared to the *h*th option with respect to the *j*th criterion. If $b_{ih}^{(j)}>1$, then the *i*th option is better than the *h*th option, while if $b_{ih}^{(j)}<1$, then the *i*th option is worse than the *h*th option. If two options are evaluated as equivalent with respect to the *j*th criterion, then the entry $b_{ih}^{(j)}$ is 1. The entries $b_{ih}^{(j)}$ and $b_{hi}^{(j)}$ satisfy the following constraint:

$$b_{ih}^{(j)} \cdot b_{hi}^{(j)} = 1 \quad \text{.....(2.7)}$$

And $b_{ii}^{(j)}=1$ for all *i*. An evaluation scale similar to the one introduced in Table 2.1 may be used to translate the decision maker's pairwise evaluations into numbers.

Second, the AHP applies to each matrix $\mathbf{B}^{(j)}$ the same two-step procedure described for the pairwise comparison matrix **A**, i.e. it divides each entry by the sum of the entries in the same column, and then it averages the entries on each row, thus obtaining the score vectors $\boldsymbol{s}^{(j)}$,*j=1,…,m*. The vector $\boldsymbol{s}^{(j)}$ contains the scores of the evaluated options with respect to the *j*th criterion.

Finally, the score matrix **S** is obtained as

$$\mathbf{S}=[\, \boldsymbol{s}^{(1)} \ldots \boldsymbol{s}^{(m)}] \quad \text{..... (2.8)}$$

c) Ranking the options

Once the weight vector ***w*** and the score matrix **S** have been computed, the AHP obtains a vector **v** of global scores by multiplying **S** and **w**, i.e.

$$v = S \cdot w \qquad \text{..... (2.9)}$$

The *i*th entry v_i of v represents the global score assigned by the AHP to the *i*th option. As the final step, the option ranking is accomplished by ordering the global scores in decreasing order [19].

On the other hand, to write in easy terms, based on AHP, a composite model using equation modeling for goal will be established with weighted values(w) of involved factors. This finding helps criterion knowing the importance of each alternative(a) and improving on it.

Goal achievement = w1(a*X*) + w2(a*X*) + w3(a*X*) + w4(a*X*) .....(2.10)

where w is weighted value of each alternative, obtained from AHP

Example of AHP

A factory would like to buy materials to production but there are three shops offer its. To the right decision, the factory have to choose only a shop from them. The objectives are finding a best choice that have suitable price, good quality, punctuality and reliability.

Solution

1) Structure the decision hierarchy from the top with the goal of the decision, then the objectives from a broad perspective, through the intermediate levels (criteria on which subsequent elements depend) to the lowest level(which usually is a set of the options or alternatives)

2) Computing the vector of criteria weights, construct a set of pairwise comparison matrices. Each element(criterion) in upper level is used to compare the elements in the level immediately below with respect to it

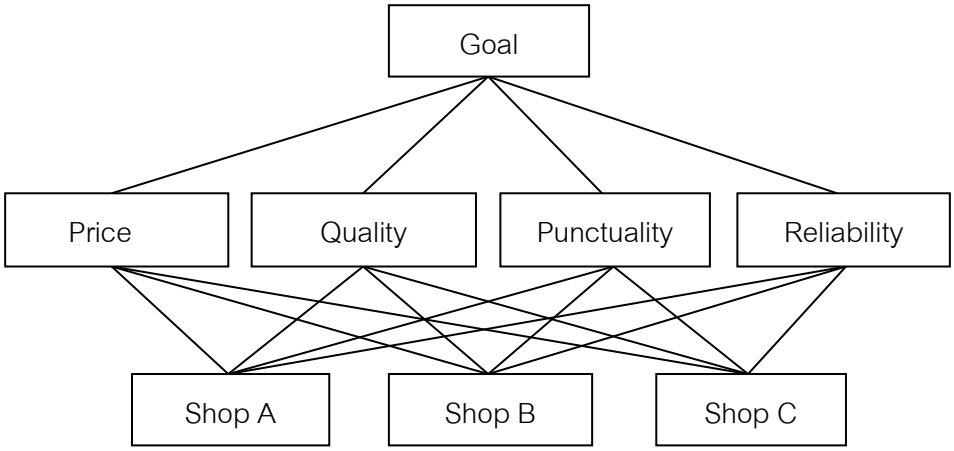

Figure 2.9 AHP structure to decision choosing a shop

Table 2.2 Criteria pairwise comparison matrix **A**

category	Price	Quality	Punctuality	Reliability
Price	1	1/3	1	3
Quality	3	1	3	3
Punctuality	1	1/3	1	1
Reliability	1/3	1/3	1	1
Sum on Column	5.33	2.00	6.00	8.00

Scoring for category importance

a_{jk} = 1/3 meaning a_k is more important than a_j

a_{jk} = 1 meaning a_k is almost same as a_j

a_{jk} = 3 meaning a_j is more important than a_k

After building of matrix **A**, it is possible to derive the normalized matrix **A** by making equal to 1 of the entries on each column by Equation(2.4) and then get w_j values by Equation(2.5)

The derived scale based on the judgements show that the highest weight is quality(0.48), following with Price(0.23), Punctuality(0.16) and Reliability(0.13) respectively

Table 2.3 Normalized pairwise comparison matrix $\mathbf{A}_{norm}$ and criteria weight vector w

category	Price	Quality	Punctuality	Reliability	w_j
Price	0.19	0.17	0.17	0.38	**0.23**
Quality	0.56	0.49	0.49	0.38	**0.48**
Punctuality	0.19	0.17	0.17	0.12	**0.16**
Reliability	0.06	0.17	0.17	0.12	**0.13**
Sum	1.00	1.00	1.00	1.00	**1.00**

3) Computing the matrix of option scores, Before building a matrix **S**, we have to find matrix $\mathbf{B}^{(j)}$ first. Matrix $\mathbf{B}^{(j)}$ is a option matrix(or a shop matrix in this case). It represents the evaluation of options rely on each criterion. The AHP applies to each matrix $\mathbf{B}^{(j)}$ the same procedure described for matrix **A**. We show Matrix **B** only on quality criterion, the others is in the same way.

Table 2.4 Option pairwise comparison matrix **B** on criterion of quality

quality	Shop A	Shop B	Shop C
Shop A	1	1/3	3
Shop B	3	1	3
Shop C	1/3	1/3	1
Sum on Column	4.33	1.67	7

Table 2.5 Normalized matrix $B^{(j)}_{norm}$ and option weight vector s on criterion of quality

quality	Shop A	Shop B	Shop C	s_i
Shop A	0.23	0.20	0.43	**0.29**
Shop B	0.69	0.60	0.43	**0.57**
Shop C	0.08	0.20	0.14	**0.14**
Sum on Column	1	1	1	**1**

The vector $s^{(j)}$ contains the scores of the evaluated options with respect to the *j*th criterion. Finally, the score matrix **S** is obtained as table 2.6

Table 2.6 The score of matrix **S**

	Price	Quality	Punctuality	Reliability
Shop A	0.33	0.29	0.32	0.43
Shop B	0.10	0.57	0.22	0.47
Shop C	0.57	0.14	0.46	0.10

4) Ranking the options, from Equation(2.9) the vector v summarize the global score assigned by the AHP, shown in table 2.7

Table 2.7 Matrix v ranking options

choice	Price(0.22)	Quality(0.48)	Punctuality(0.16)	Reliability(0.13)	
Shop A	(0.33)(0.22) + (0.29)(0.48) + (0.32)(0.16) + (0.43)(0.13) =				**0.32**
Shop B	(0.10)(0.22) + (0.57)(0.48) + (0.22)(0.16) + (0.47)(0.13) =				**0.39**
Shop C	(0.57)(0.22) + (0.14)(0.48) + (0.46)(0.16) + (0.10)(0.13) =				**0.28**

Matrix v shows that Shop **B**, the result from AHP, is the most interesting following by Shop **A** and Shop **C** respectively. And then the factory have adequate reasons to choose Shop **B** although the Price is higher than the others.[20]

2.2 Literature Reviews

Satu Jumisko-Pyykko[21] had studied variables which influence picture evaluation on mobile phone by used statistic method finding relevant factor. He found that important variables were age ,experience, preference in mobile technology and knowledge about imaging technology

Michael E. Miller and Rise Segur[22] studied quality of photography. They found that it depend on resolution of digital camera and factors impact to customer's acceptance. It conclude that

-The results indicate that the resolution of the capture device is highly correlated with the perceived quality and the proportion of acceptable prints.

-Who had both photography and computers experience would received quality more than other group.

Salmi Hanne et al.[23] studied quality attributes of image affecting to customers. They found that the most affecting set of attributes was sharpness, noise, contrast, colorfulness and gloss

CHAPTER III

EXPERIMENTAL

3.1 Materials and Equipment

Followings are the material and equipment used in this study:

- **SPSS Program**, software for calculating answers on questionnaires
- **5 Photobook Samples** in various size, price, material etc.
- **Print Test Form** downloaded from http://www.colour-science.com/
- **Macbeth Color Checker Chart**
- **X-Rite Spectro-Densitometer**
- **HP Scanjet 4400C Scanner**
- **SFRMAT File** running on MATLAB program developed by Peter Burns to measure the sharpness of the samples. It provides a spatial frequency response (SFR) from a digital image file containing a slanted-edge feature. The specific edge-gradient algorithm is based on the intent of the standard ISO 12233

3.2 Procedure

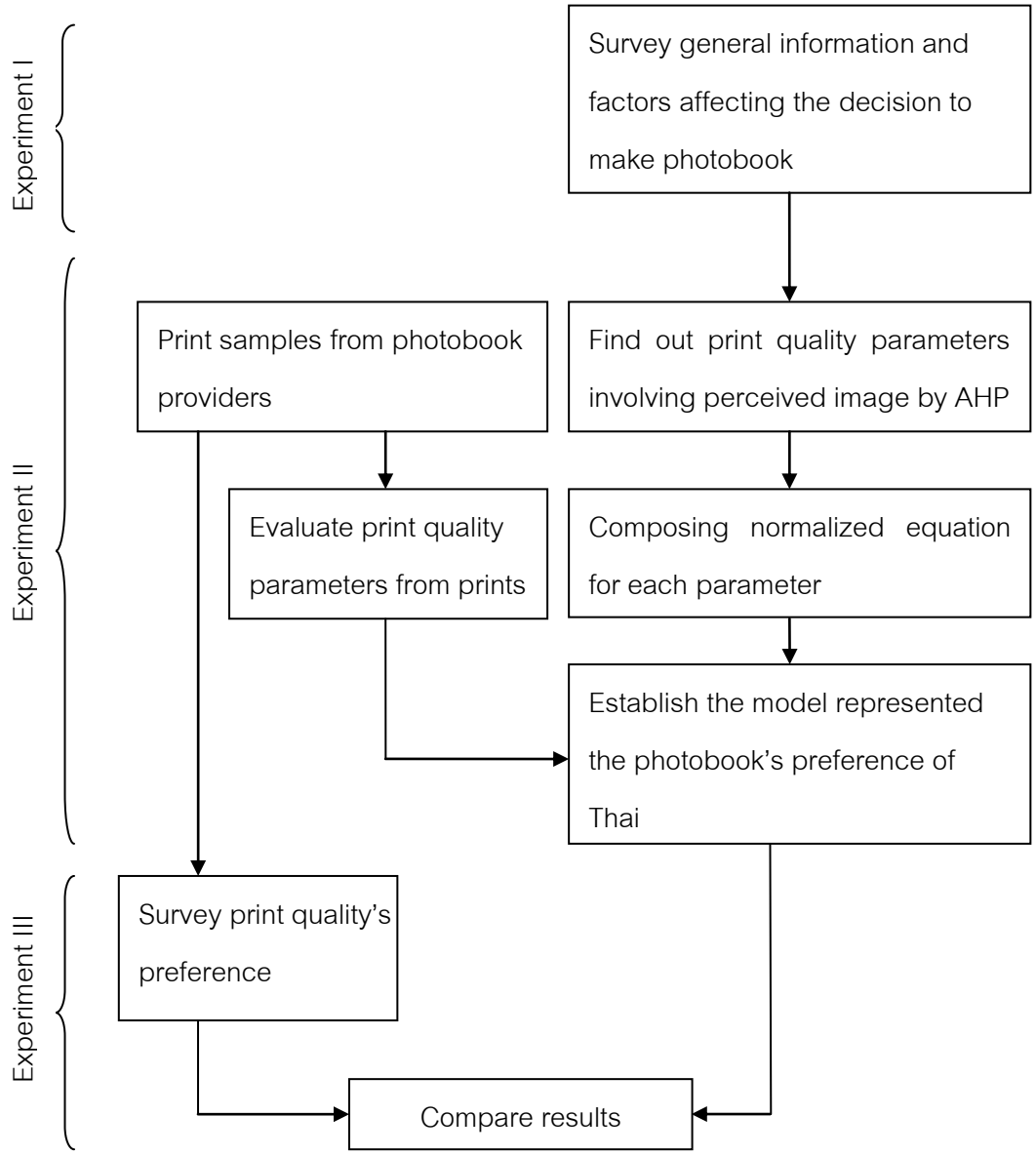

Figure 3.1 shows the diagram of procedure outline. It is divided into 3 experiments.

The procedure was divided into 3 experiments, in each experiment has a questionnaire. It was on Chulalongkorn University students but different groups. Before students filled out questionnaire, photobook samples was introduced into students. The first questionnaire in experiment I (a questionnaire shown on Appendix A part I) was based on general information of the interviewee and factors affecting the decision of photobook making. The second questionnaire in experiment II (a questionnaire shown

on Appendix A part II) was about print quality parameters by AHP methodology. The last questionnaire in experiment III (a questionnaire shown on Appendix A part III) gives interviewees ranking the preference of print test chart receiving from 5 photobook provider. In the experiment III, interviewees were treated not only photobook but also print parameters knowledge. The experiment II and the experiment III were designed because of the results of experiment I.

The chosen factors affecting the decision of photobook making were gathered from the literature review. They were price, design, cover, bindery, materials, print quality, size and others. For print quality parameters, the data was obtained from 5 photobook makers who graduated as B.Sc. degree in Printing Technology. The frequently used print quality parameters are tone reproduction, contrast, resolution, color matching and sharpness.

3.2.1 Experiment I

The data on this section inquiries from 53 young Thai, divided into 32 females and 21 males with their age ranged between 17 and 23 years old. In the questionnaire I, it was separated into the general information and the ranking factors. The general information questionnaire asked to fill out their sex, age, and general information related to photobook. The other asked to rank the factors affecting the decision of the photobook making.

3.2.1.1 General information

This part had both open-ended and closed-ended questions as follows:

- What is your hobby? [open-ended questions]
-How do you think about photobook? [open-ended questions]
- Do you like photography? [closed-ended questions(checklists)]

  The choices are : *Yes and No*
- How do you print photos? [closed-ended questions(checklists)]

The choices are : *Home printer, Mini lab/photo service, Never print and Others*

- Do you know photobook? [closed-ended questions(checklists)]

The choices are : *Yes and No*

- Which activity is photobook suit for? [closed-ended questions(checklists)]

The choices are : *wedding, travel, family, company profile, graduation, others*

- How often do you make photobook yearly in case you know photobook? [closed-ended questions(checklists)]

The choices are : *1, 2, 3, 4, more than 4 and none*

3.2.1.2 Ranking the factors

- Ranking the factors that influence your decision to make a photobook [closed-ended questions(Ranking)]

The choices are : *price, lay out/graphic design, bindery, print quality, size, cover, quality of materials and others*

3.2.2 Experiment II

The objective of this experiment was to establish the preference's equation of print quality based on print parameters and Analytic Hierarchy Process theory (AHP). The equation that was established in this experiment was compared to the result of experiment III. If both results were in the same way, it meant that the equation was reliable.

3.2.2.1 Questionnaire II Weight of print quality parameters

The data inquiries from 50 young Thai, divided into 25 females and 25 males with their age ranged between 17 and 23 years old. Based on AHP analysis of each parameter relating to customers' satisfaction, the important weight value of each parameter was obtained. The weights were used to establish the equation. Data in AHP

analysis sheet was given in Table 3.1. These parameters were contrast, resolution, tone reproduction, color matching and sharpness. The interviewee would be asked to give score of category importance from 1/9 to 9 by comparing entities (factors/ parametets/alternatives) in pairs to judge which of each parameter is preferred into AHP table.

Table 3.1 AHP table

		X				
		Contrast	Resolution	Tone reproduction	Color matching	Sharpness
Y	Contrast	1				
	Resolution		1			
	Tone reproduction			1		
	Color matching				1	
	Sharpness					1

Table 3.2 Scores for category importance for AHP table

scoring for category importance	
9	***X*** is much more important to the max
7	***X*** is much more important
5	***X*** is more important
3	***X*** is a bit more important
1	***X*** is almost same as ***Y***
1/3	***Y*** is a bit more important
1/5	***Y*** is more important
1/7	***Y*** is much more important
1/9	***Y*** is much more important to the max

3.2.2.2 Preference's equation modeling

To clarify the AHP analysis, loading factors or parameters' weights received from 3.2.2.1 were considered. The larger the value of the parameter's weight, the higher the importance of the young Thai determine the quality of print in photobook. Thus, preference's equation of photobook based on print quality could be established as given in Equation 3.1.

$$P = W_1N_1 + W_2N_2 + W_3N_3 + W_4N_4 + W_5N_5 \quad \text{.....(3.1)}$$

where

P : preference score

W : parameter's weight value, by which $W_1+W_2+..+W_5=1$

N : normalized value of each print quality parameter, $0 \leq N \leq 1$

Normalization is the process of isolating statistical error based on the magnitude of the measures. This allows underlying characteristics of the data sets on different scales to be compared by bringing them to a common scale. In this experimental context, the normalization is the ratio of the apparent measured value of each print quality parameter to its relevant optimum value or vice versa. Note that the normalized value of each parameter(equations 3.2-3.6) should not be more than 1. For example*:*

$$C_n = \frac{C_o - |C_0 - C_p|}{C_o} \quad \text{..... (3.2)}$$

where

C_n : normalized contrast value

C_p : contrast of print

C_o : optimum contrast value obtained from Macbeth Color Checker

$$R_n = \frac{R_o}{R_p} \quad \text{.....(3.3)}$$

where

R_n : normalized resolution value

R_p : resolution obtained from print

R_o : optimum resolution value, indicated on print testform as 1 point

$$\gamma_n = \frac{\gamma_o - |\gamma_o - \gamma_p|}{\gamma_p} \quad \text{..... (3.4)}$$

where

γ_n : normalized gamma value

γ_p : gamma of sample

γ_o : optimum gamma value which ideally is preferred as 1

$$M_n = \frac{\Delta E_o}{\Delta E_p} \quad \text{.....(3.5)}$$

where

M_n : normalized color matching value

ΔE_o : recommend delta E, which will be defined as 5, based on ISO 12647-2

ΔE_p : delta E from sample

$$S_n = \frac{f_{50_p}}{f_{50_o}} \quad \text{.....(3.6)}$$

where

S_n : normalized sharpness value

f_{50_p} : 50 percent SFR frequency correlates of sample in unit of cycle/millimeter

f_{50_o} : 50 percent SFR frequency correlates of chart printed on Premium Luster paper on the Epson 2200 in unit of cycle/millimeter

3.2.2.3 Test print samples

Print samples from 5 major photobook providers in Bangkok were collected. Most of them used high-end digital printers such as Indigo and Xerox. Although they was printed from different shop, the point was the difference of print quality. The Reproduction prints were composed of elements and images such as:

- resolution target
- tone scale
- colour cast
- images of skin tones and general scene
- Colorchecker chart

The original file of test chart were downloaded from www.colour-science.com

Figure 3.2 Reference test chart

3.2.2.4 Measurement of print quality parameters on print samples

Densitometer was employed to measure contrast and tone reproduction. While color matching was evaluated through a spectro-densitometer. Sharpness of image was measured by scanning the print prior before calculating MTF using SFRMAT (M-file) running on MATLAB software. Resolution was examined by observation at the resolution target which consists of varying point size of text from 1 point to 15 points.

3.2.2.5 Solving equation

Weight of print quality parameters from survey in 3.2.2.1 and print quality parameter values of print samples in 3.2.2.3 were substituted to the Equation(3.1).

3.2.3 Experiment III

3.2.3.1 Questionnaire III Print samples' preference

This survey was due to confirm the accuracy of the Equation(3.1). 50 students including 25 males and 25 females with their age ranged between 17 and 23 years old were asked to rank the total of print quality of each print(Figure 3.2).

3.2.3.2 Result comparison

The results of young Thai preference of print quality from the survey(3.2.3.1), compared with the preference score obtained by Equation 3.1(3.2.2.5) were considered.

CHAPTER IV

RESULTS AND DISCUSSION

4.1 Experiment I

4.1.1 Survey of Questionnaire

4.1.1.1 Sex and Age

Questionnaires were categorized into three parts, the first part was about information, opinion and factors affecting decision to make a photobook. There were 53 young Thai, divided into 32 females and 21 males, with their age ranged between 17 and 23 as reported in Tables 4.1 and 4.2. Mean of age was 19.06 years old

Table 4.1 The sex of interviewee

		Frequency	Percent
Sex	female	32	60.4
	male	21	39.6
	Total	53	100.0

Table 4.2 The age of interviewee

		Frequency	Percent
Age	17	1	1.9
	18	19	35.8
	19	21	39.6
	20	5	9.4
	21	3	5.7
	22	3	5.7
	23	1	1.9
	Total	53	100.0

4.1.1.2 Hobby

It was found that the hobby of the interviewees could be categorized into six groups, 28% liked watching TV and listening music while the second largest group, 26%, was interested in playing internet and game. Other hobbies were book reading 16% and sport playing 12%. The group that took a photo as hobby was only 8%. The last 10% was other activities, as shown in Table 4.3.

Table 4.3 Interviewees' hobby

		Responses
		percent
Interviewees' hobby	Watching TV& Listening a music	28%
	Internet& Game	26%
	Reading a book	16%
	Playing sport	12%
	Taking photos	8%
	Others	10%
Total		100%

4.1.1.3 Like or dislike photography

Table 4.4 Preference photography divided by sex

			Sex		Total
			female	male	
Do you like photography?	like photograph	Count	27	13	40
		% within sex	84.4%	61.9%	75.5%
	don't like	Count	3	4	7
		% within sex	9.4%	19.0%	13.2%
	no comment	Count	2	4	6
		% within sex	6.2%	19.0%	11.3%
Total		Count	32	21	53
		% within sex	100.0%	100.0%	100.0%

The objective of this question was to know if the interviewees like photography and to check the accuracy of previous question about hobby. The result was given in Table 4.4. The vast majority of opinion (75.5%) was "*like"* photography. 13.2% gave negative response. Others were "*no comment*". However, It seemed that there was a conflict to previous question about interest hobby that only 8% took a photography as hobby.

4.1.1.4 Place to print photos

This question was close-ended question. An interviewee could choose the answer more than one choice. For example, an interviewee who chose "*don't print*" couldn't choose "*print at home*" or "*print at shop*". Likewise, if he/she chose "*print at home*" or "*print at shop*" could not choose "*don't print*". Decision on both home and shop was available. The results are given in Table 4.5. The young Thai (59.6%) preferred printing photographs at shops which was a convenient way. 19.3% represented printing at home. This implied that the quality of modern home printer was good enough to print photographs, while 21% gave negative response as "*don't print*". This may be due to the achievement of storage and display technology.

Table 4.5 Where observer print photographs

		Responses	
		N	Percent
Print	don't print	12	21.1%
	print at home	11	19.3%
	print at shop	34	59.6%
Total		57	100.0%

4.1.1.5 Photobook recognition

This question focuses on how the interviewees know photobook. There was 59.6% who knew it before, whereas 40.4% never knew it. 75% of female knew the photobook while only 35 percent of male knew it.

Table 4.6 Photobook recognition of the young Thai

			Sex		Total
			female	male	
know photo book	know photobook	Count	24	7	31
		% within sex	75.0%	35.0%	59.6%
	don't know photobook	Count	8	13	21
		% within sex	25.0%	65.0%	40.4%
Total		Count	32	20	52
		% within sex	100.0%	100.0%	100.0%

4.1.1.6 What they think about photobook

This part was open-ended question asking about how the young Thai think about photobook. The responses were various. However, they could be divided into three groups: positive, negative, and moderate thinking as given in Table 4.7.

Table 4.7 Interviewees thinking about photobook

Positive	Moderate	Negative
- suitable for keeping - looking different from traditional printing - easy to store photograph - to give or show on special occasion	- no comment - knew it before but didn't see it yet	- too expensive - design and quality is not good enough

4.1.1.7 Activities related photobook

Interviewees were able to choose more than one choice. Table 4.8 shows the results of percentage responses. These activities fell into three groups. The high impacts were "*graduation*", "*school yearbook*" and "*wedding*". Medium impacts were "*travel*" and "*family*". The low impacts were "*company profile*" and "*others*". "*Graduation*" showed the highest frequencies at 22.1% while "*school yearbook*" and

“wedding” represented 20.7% and 20.0% respectively. It was noticeable that all of interviewee was still a student in the university and then these choices probably related to them.

Table 4.8 Ranking of activities related to photobooks

		Responses	
		N	Percent
Activities	graduation	31	22.1%
	school yearbook	29	20.7%
	wedding	28	20.0%
	travel	23	16.4%
	family	19	13.6%
	company profile	8	5.7%
	others	2	1.4%
Total		140	100.0%

4.1.2 Factors affecting the decision of photobook making

Table 4.9 gives the combination arithemetic means of each factor affecting the decision of the young Thai to make a photobook, which could be ranked by numbers.

$$Combined\ Arithematic\ Mean = \frac{\sum N_i \bar{X}_i}{\sum N_i}$$

where

N_i : Number of Observers in rank i

$\bar{X}_i$: Score of rank i,

if rank i =1, score = 8

if rank i =2, score = 7

⋮

if rank i =8, score = 1

Table 4.9 Combination arithemetic means of factors

	N	Combined arithemetic means	SD	Ranking
print quality	48	6.90	1.30	1
design	48	6.79	1.09	2
materials	48	5.31	1.56	3
price	48	4.96	2.09	4
attractive cover	48	3.79	1.52	5
bindery	48	3.73	1.36	6
size	48	3.46	1.54	7
others	48	1.06	0.43	8

Note that these ranking scores were obtained from 48 interviewees as 5 interviewees did not complete the question. However, to know that the means within Table 4.9 had a difference between groups or not, analysis of variance(ANOVA) was applied. ANOVA is a particular form of statistical hypothesis testing. If the significance value of f-test was less than f value of critical value, the null hypothesis was rejected. Table 4.10 was the result of ANOVA. The f-value was 86.06, more than f value of critical ($F_{7;376;0.95}$= 2.01), it meant that there were statistically significant different between groups. Then t-test also applied to determine the difference of means. The results of t-test shown on Tables 4.10 and 4.11 were summarized from Appendix B. From the Table 4.9, “print quality” had the highest mean at 6.90 and the second “size” had the lower score at 6.97, however t-test indicated that both values had no significant difference then both factors had the highest impact on photobook decision making. Factors “materials” and “price” had no significant difference but had significant difference from “print quality” and “design”, thus they played a role as the second influence. Factors “attractive cover”, “bindery” and “size” had no significant different between them, however they had significant different on factors above, thus they were the third impact. The factor “others” was the last point almost no influence.

Table 4.10 1-WAY ANOVA of factors

	df	*Sum of Squares*	*Mean Square*	F
Between Groups	7	1241.25	177.32	86.06
Within Groups	376	774.75	2.06	
Total	383	2016.00		

Table 4.11 T values of pair t-test of factors at 95% confidence

Factor	$\bar{x}$	SD	T	*Factor*	$\bar{x}$	SD	T
print quality	6.90	1.31	-0.358	attractive cover	3.79	1.53	-0.206
Design	6.79	1.10		bindery	3.73	1.36	
Design	6.79	1.10	4.653	bindery	3.73	1.36	0.799
Materials	5.31	1.56		size	3.46	1.54	
Materials	5.31	1.56	-0.862	attractive cover	3.79	1.53	-1.086
Price	4.96	2.09		size	3.46	1.54	
Price	4.96	2.09	2.571	size	3.46	1.54	10.241
attractive cover	3.79	1.53		others	1.06	0.43	

Table 4.12 Results of pair t-test of factors at 95% confidence

Factor	$\bar{x}$	T	*Factor*	$\bar{x}$	T
print quality	6.90	No significant difference	attractive cover	3.79	No significant difference
Design	6.79		bindery	3.73	
Design	6.79	Significant difference	bindery	3.73	No significant difference
Materials	5.31		size	3.46	
Materials	5.31	No significant difference	attractive cover	3.79	No significant difference
Price	4.96		size	3.46	
Price	4.96	Significant difference	size	3.46	Significant difference
attractive cover	3.79		others	1.06	

A standard deviation of "*price*" was noticeable due to its value was higher than the others. This implied that "*price*" had a wide gap of response.

Even though "*print quality*" and "*design*" gave the same rank, number 1, but only "*print quality*" was researched in this project.

4.2 Experment II

4.2.1 AHP analysis

4.2.1.1 Interviewees information

50 interviewees (25 males and 25 females) with age ranging from 17 to 24 years old, were requested to identify the category importance or weight of print quality parameters by AHP method. Their information was given in Tables 4.13, 4.14.

Table 4.13 Interviewees on surveying AHP analysis

		Frequency	Percent
Sex	female	25	50.0
	male	25	50.0
	Total	50	100.0

Table 4.14 Age of interviewee on surveying AHP analysis

		Frequency	Percent
Age	17	1	2.0
	18	9	18.0
	19	18	36.0
	20	9	18.0
	21	8	16.0
	22	3	6.0
	23	1	2.0
	24	1	2.0
	Total	50	100.0

4.2.1.2 Important weight of parameters

Based on AHP analysis, the category importance or weight of each print quality parameter was obtained and given in Table 4.15. Print resolution showed the highest consideration of the young Thai towards print quality, with the weight value at 0.27. Tone reproduction, contrast and sharpness gave less important consecutively. It should be noted that “color matching” parameter was estimated at least important with the weight value at 0.12.

Table 4.15 Category importance (weight) of print quality parameters

Contrast	Resolution	Tone reproduction	Color matching	Sharpness
0.20	0.27	0.22	0.12	0.18

Thus, the print quality preference of the young Thai in Equation (3.1) could be rewritten as

$$P = 0.2C_n + 0.27R_n + 0.22\gamma_n + 0.12M_n + 0.18S_n \quad \text{.....(4.1)}$$

4.2.2 Evaluation of print quality parameters

Tables 4.16 – 4.23 and Figures 4.1-4.6 were the results of measured print quality parameters obtained from the printed samples. The measured contrast values showed higher and lower than the standard one measured on Macbeth color checker (Table 4.16). For the resolution, all printed samples could not the reach the optimum value as 1 point size (Table 4.17). Figure 4.1 shows the tone reproduction curves of each printed samples, at gray scale images. Their measured densities and gamma values at mid-tone were given in Table 4.18 and 4.19, respectively. It was found that all printed samples had their gamma values higher than the expected optimum (1.00), with the exception of printed sample D. Table 4.20 showed color difference values of each printed samples compared with the colors from the Macbeth Color Checker. Results showed that all samples gave higher color difference values than expected. These values were not much different from one another. Figures 4.2 – 4.6 showed the MTF

curves of each printed sample, by which its sharpness was determined at 50% MTF. Results were given in Table 4.21. Printed sample D gave lowest sharpness quality at value 2.80.

Table 4.16 Contrast

	D_{min}	D_{max}	C_p
sample A	0.11	2.46	2.35
sample B	0.10	2.60	2.50
sample C	0.08	2.42	2.34
sample D	0.10	2.04	1.94
sample E	0.09	2.29	2.20
Macbeth	0.09	2.10	2.01

Table 4.17 Resolution

	Printed samples				
	A	B	C	D	E
R_p	2	2	2	4	3

Table 4.18 Gray level densities of printed samples

Step			Printed samples					
			A	B	C	D	E	Macbeth Color Checker
Density	1		0.11	0.1	0.08	0.1	0.09	0.09
	2		0.11	0.11	0.1	0.11	0.12	0.25
	3		0.42	0.38	0.38	0.36	0.45	0.48
	4		0.85	0.87	0.76	0.65	0.93	0.81
	5		1.53	1.67	1.39	1.17	1.63	1.36
	6		2.46	2.32	2.42	2.04	2.29	2.1

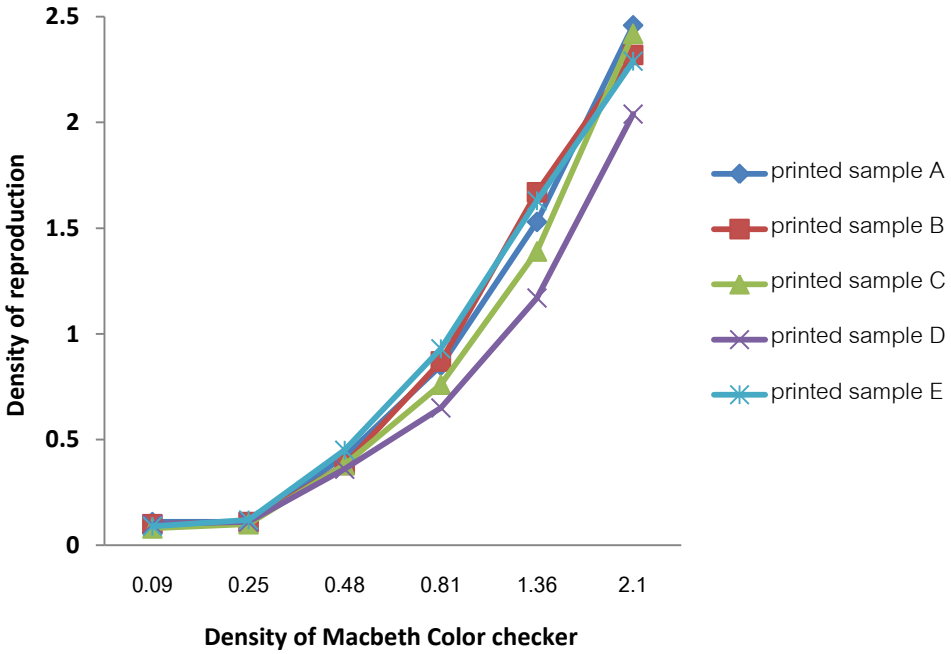

Figure 4.1 Tone reproduction of printed samples

Table 4.19 Gamma

	Printed samples				
	A	B	C	D	E
γ_p	1.28	1.42	1.16	0.94	1.36

Table 4.20 Average delta E of samples

	Printed samples				
	A	B	C	D	E
ΔE_p	13.69	15.50	13.69	13.34	15.11

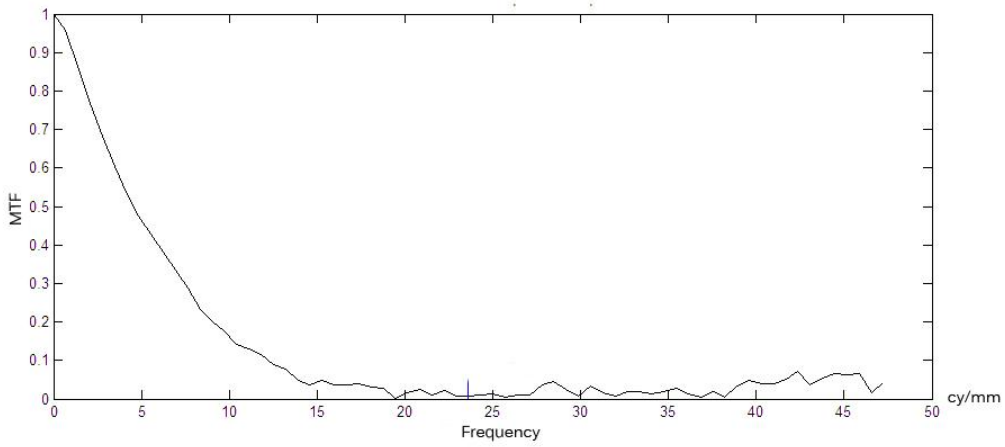

Figure 4.2 MTF curve of printed sample A

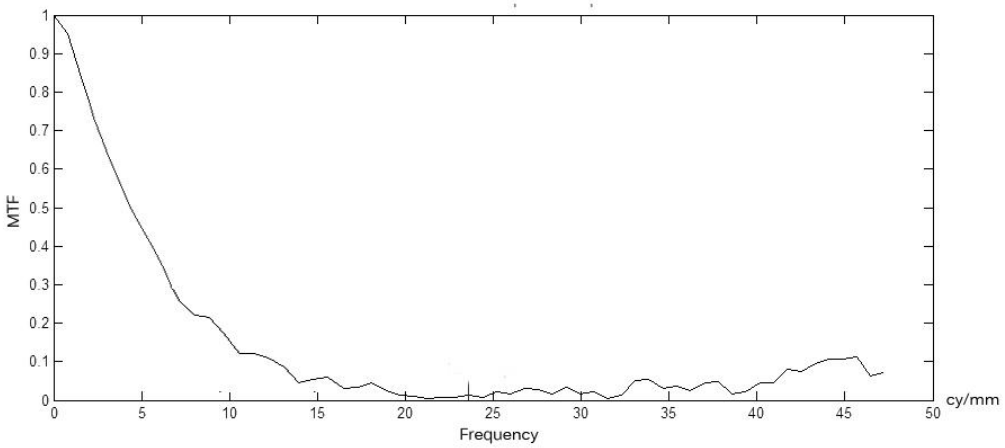

Figure 4.3 MTF curve of printed sample B

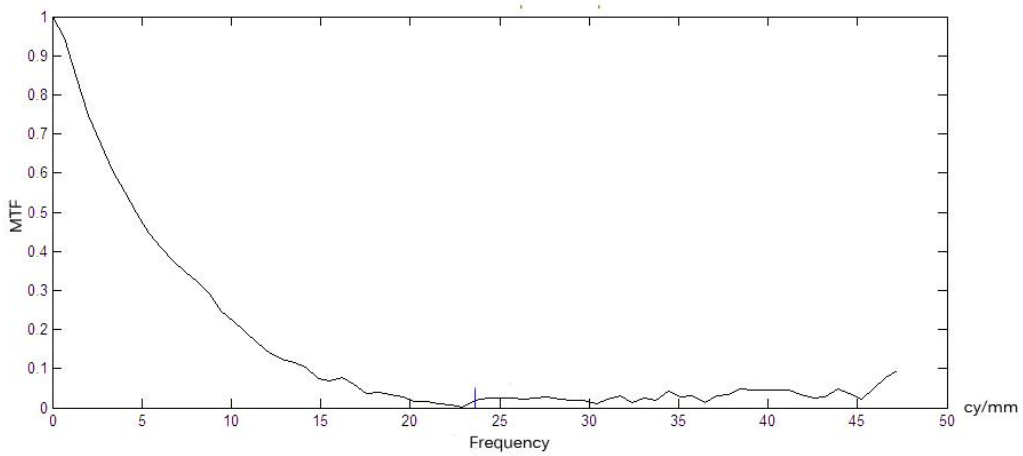

Figure 4.4 MTF curve of printed sample C

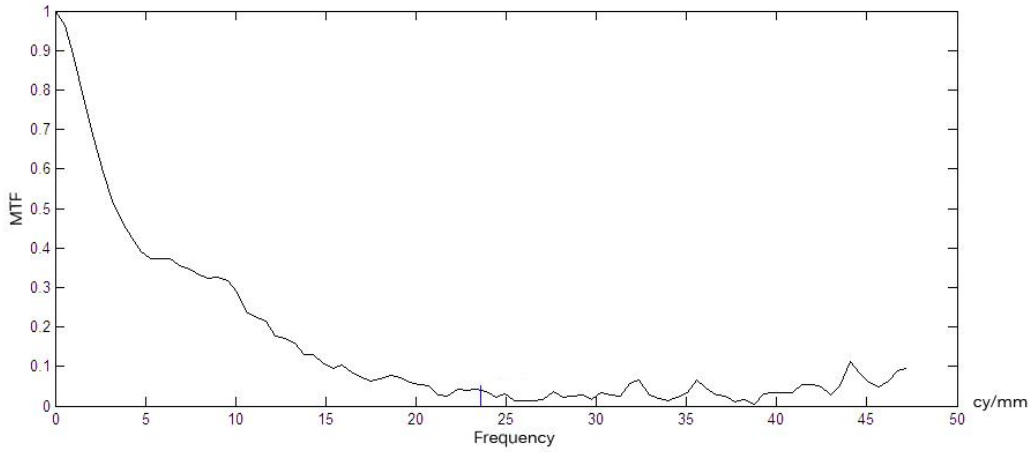

Figure 4.5 MTF curve of printed sample D

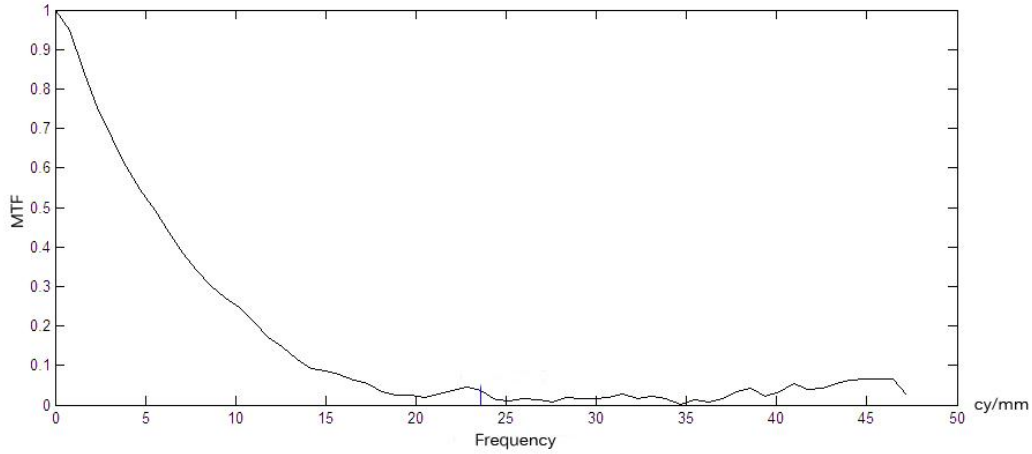

Figure 4.6 MTF curve of printed sample E

Table 4.21 Sharpness values at 50% MTF

	Printed samples				
	A	B	C	D	E
f_{50_p}	4.70	4.77	4.70	2.80	5.39

4.2.3 Normalization of measured print quality parameters

As all data set of print quality parameters is different, normalization process is thus needed. It is the ratio of the measured value to its relevant optimum value. Results are given in Table 4.22.

Table 4.22 Normalized values of each print quality parameter

	contrast		resolution		gamma		colour matching		MTF	
	C_p	C_n	R_p	R_n	γ_p	γ_n	ΔE_p	M_n	f_{50_p}	S_n
A	2.46	*0.83*	2.00	*0.50*	1.28	*0.72*	13.69	*0.37*	4.70	*0.69*
B	2.60	*0.76*	2.00	*0.50*	1.42	*0.58*	15.50	*0.32*	4.77	*0.70*
C	2.42	*0.84*	2.00	*0.50*	1.16	*0.84*	13.69	*0.37*	4.70	*0.69*
D	2.04	*0.97*	4.00	*0.25*	0.94	*0.94*	13.34	*0.37*	2.80	*0.41*
E	2.29	*0.91*	3.00	*0.33*	1.36	*0.64*	15.11	*0.33*	5.39	*0.79*
optimum	2.10		1.00		1.00		5.00		6.86	

Then the print quality preference value could be calculated using Equation (4.1). Table 4.23 shows the results of calculated preference values of each printed sample.

Table 4.23 Calculated print quality preference values of each printed sample

	C_n	R_n	γ_n	M_n	S_n	Pref.
A	(0.2)(0.83) +	(0.27)(0.50) +	(0.22)(0.72) +	(0.12)(0.37) +	(0.18)(0.69) =	**0.63**
B	(0.2)(0.76) +	(0.27)(0.50) +	(0.22)(0.58) +	(0.12)(0.32) +	(0.18)(0.52) =	**0.58**
C	(0.2)(0.84) +	(0.27)(0.50) +	(0.22)(0.84) +	(0.12)(0.37) +	(0.18)(0.69) =	**0.65**
D	(0.2)(0.97) +	(0.27)(0.25) +	(0.22)(0.94) +	(0.12)(0.37) +	(0.18)(0.41) =	**0.59**
E	(0.2)(0.91) +	(0.27)(0.33) +	(0.22)(0.64) +	(0.12)(0.33) +	(0.18)(0.79) =	**0.59**

4.3 Experiment III

4.3.1 Survey print samples' quality

4.3.1.1 Observer information

The survey was conducted by choosing the preferable printed samples. The print samples were obtained from 5 major photobook providers in Bangkok, named as A, B, C, D and E. The prints represented skin tone and scenery images. In addition, it

consisted of tools for evaluating print quality parameters such as sharpness, gamma, color, etc. The observers were Chulalongkorn University students: 25 females and 25 males as given in Table 4.24, with their age between 17 to 23 years old (Table 4.25).

Table 4.24 Observers on surveying the preference of printed samples

		Frequency	Percent
Sex	female	25	50.0
	male	25	50.0
	Total	50	100.0

Table 4.25 Age of observers on surveying the preference of printed samples

		Frequency	Percent
Age	17	2	4.0
	18	8	16.0
	19	17	34.0
	20	10	20.0
	21	10	20.0
	22	2	4.0
	23	1	2.0
	Total	50	100.0

4.3.1.2 Ranking scores of printed samples

A combined arithemetic means method was used to analyze the ranking of print quality preference, the results were given in Table 4.26. And to confirm that the means in Table 4.26 were different or not, ANOVA was applied. The result of ANOVA showed on Table 4.27. The F-test value was 43.16, it was more than critical value that F critical ($F_{4;245;0.95}$) was 2.37, it implied that there were at least one pair of samples different. Then the sample scores in Table 4.26 was determined by t-test and the results were on Tables 4.28 and 4.29. The t-test of means shows that the printed samples from shop D and E gave no significant difference at 95 % confidence, while the others were significant difference. Thus the results from Tables 4.26-4.29 concluded that printed

sample from shop C was the highest combined arithemetic means value with ranking number 1. Shop A was number 2. Shop D and E were the same rank as number 3. Shop E was the last rank as number 4.

Table 4.26 Preference ranking of printed samples

		N	Combined arithemetic means	SD
Sample	Shop A	50	3.66	1.10
	Shop B	50	1.50	0.93
	Shop C	50	4.16	1.06
	Shop D	50	2.68	1.00
	Shop E	50	3.00	1.34

Table 4.27 1-WAY ANOVA of printed samples

	df	*Sum of Squares*	*Mean Square*	F
Between Groups	4	206.68	51.67	43.16
Within Groups	245	293.32	1.20	
Total	249	500.00		

Table 4.28 T values of pair t-test of factors at 95% confidence

Factor	$\bar{x}$	SD	T	*Factor*	$\bar{x}$	SD	T
Shop A	3.66	1.10	9.896	Shop B	1.50	0.93	-5.534
Shop B	1.50	0.93		Shop D	2.68	1.00	
Shop A	3.66	1.10	-2.103	Shop B	1.50	0.93	-5.789
Shop C	4.16	1.06		Shop E	3.00	1.34	
Shop A	3.66	1.10	3.948	Shop C	4.16	1.06	7.236
Shop D	2.68	1.00		Shop D	2.68	1.00	
Shop A	3.66	1.10	2.413	Shop C	4.16	1.06	3.937
Shop E	3.00	1.34		Shop E	3.00	1.34	
Shop B	1.50	0.93	-12.374	Shop D	2.68	1.00	-1.205
Shop C	4.16	1.06		Shop E	3.00	1.34	

Table 4.29 Results of pair t-test of factors at 95% confidence

Factor	$\bar{x}$	T	*Factor*	$\bar{x}$	T
Shop A	3.66	Significant difference	Shop B	1.50	Significant difference
Shop B	1.50		Shop D	2.68	
Shop A	3.66	Significant difference	Shop B	1.50	Significant difference
Shop C	4.16		Shop E	3.00	
Shop A	3.66	Significant difference	Shop C	4.16	Significant difference
Shop D	2.68		Shop D	2.68	
Shop A	3.66	Significant difference	Shop C	4.16	Significant difference
Shop E	3.00		Shop E	3.00	
Shop B	1.50	Significant difference	Shop D	2.68	No significant difference
Shop C	4.16		Shop E	3.00	

4.3.2 Comparing results from two methods

Table 4.30 Compared results from both methods

		Scores from survey	Scores from equation
Sample	A	3.66	0.63
	B	1.50	0.58
	C	4.16	0.65
	D	2.68	0.59
	E	3.00	0.59

Results of ranking score of 5 printed samples from the survey and calculation using print quality preference equation were compared. Even the unit base of these two methods was different, however the sequence could be compared within each process By the way, Ranking from the survey was “C>A>E>D>B”. But “E” and “D” showed no significant difference by t-test. Thus its conclusion should be “C>A>E=D>B”. While preference ranking from the calculation was “C>A>E=D>B”. It could be said that it is

possible to establish the print quality preference equation as the result relates to real observation. This would help the photobook print shops to predict their products how to satisfy young Thai customers.

CHAPTER V

CONCLUSIONS AND SUGGESTION

5.1 Conclusions

Personal photobook has grown rapidly for the past few years because of many reasons such as advancement of printing technology, internet and design program, etc. However, the next few years, it is still growing up due to more than 40% of interviewees never know photobooks. Thus this research was necessary to understand how the customers are thinking about a photobook. The findings would benefit to many photobook providers to improve their service and to make a better product.

The experiment I was found that the factors which had most influence of the young Thai's decision to making a photobook were "print quality" and "design". The "price" was less influence than those factors but it had noticeable wide standard deviation value. It is implied that the some young does not concern much about the price if the photobook has good qualities.

Although print quality and design became the prior factors, this research focused on only print quality. To know that what the parameters in print quality had influence to make a photobook, Experiment II was designed to clarify the parameters. AHP analysis was used to analyze the category important of each print quality parameter whereby the print quality preference equation was established.

Experiment III was designed to confirm the accuracy of the equation in experiment II. The print samples from 5 photobook providers which had difference in quality were printed. It was ranked by observers.

The reliability of calculation from the equation was compared with the result by observation. It was shown that both methods gave the same ranking sequence of

samples. Thus, it was possible to use this equation to predict print qualities preference of the young Thai.

5.2 Suggestions

As the surveys were conducted by only students, with their age ranged between 17-24 years old, the results might not be the same as others groups that did not be students. For example, the questionnaire's question was concerned about "what activity photobook suit for", the top rank and the second were related to education while the less ranks didn't relate to education. Therefore, it is suggested that the next surveys should add on other population of interviewees as well.

Although all surveys in this research was on the students, they were different groups. The opinion on each group may not have on the same way. For example, the experiment I concluded that print quality was the best factor, by which experiment II was designed based on that conclusion. In experiment II, the new survey was on the other group. The conclusion of experiment II may be wrong if the most important factor of the new survey group was not a print quality. Consequently, future study should survey all experiment on the same time and group.

The almost observers in this study never make a photobook before and didn't certainly make in the future. On the one hand, the conclusion would be more useful if the survey was on direct consumers.

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APPENDICES

APPENDIX A

Part I General information and Interesting Factors

1-1. ชื่อ_____เพศ_____อายุ_____

ชั้นปี _____คณะ_____

1-2. งานอดิเรก _____

1-3. ชอบถ่ายรูปหรือไม่

☐ ชอบ ☐ ไม่ชอบ ☐ ไม่มีความเห็น

1-4. ปกติ พิมพ์ภาพถ่ายอย่างไร (เลือกได้มากกว่า 1 คำตอบ)

☐ ไม่ปริ๊นซ์ ☐ ปริ๊นซ์เอง ที่บ้าน ☐ ร้านอัดรูป

☐ อื่นๆ ระบุ ( )

1-5. รู้จักโฟโตบุกมาก่อนหรือไม่

☐ ใช่ ☐ ไม่ใช่

1-6. มีความคิดเห็นอย่างไรเกี่ยวกับ โฟโต้บุ๊ค _____

1-7. คิดว่าโฟโตบุกเหมาะกับงานอะไร (เลือกได้มากกว่า 1 คำตอบ)

☐ งานแต่งงาน ☐ ท่องเที่ยว ☐ ภาพครอบครัว ☐ แนะนำบริษัท

☐ รับปริญญา ☐ หนังสือรุ่น ☐ อื่นๆ ระบุ ( )

1-8. ในหนึ่งปี คุณทำโฟโตบุกกี่เล่ม

☐ ไม่ทำเลย ☐ 1 เล่ม ☐ 2 เล่ม ☐ 3 เล่ม

☐ 4 เล่ม ☐ มากกว่า 4 เล่ม (เล่ม)

2-1. เรียงลำดับปัจจัย ที่มีผลต่อการตัดสินใจในการทำโฟโตบุกจากมากไปน้อยสุด (แต่ละช่องห่างกันเท่ากับ 1 คะแนน)

a) ราคา b) การออกแบบ c) การเข้าเล่ม d) คุณภาพงานพิมพ์
e) ขนาด f) ปก g) วัสดุ เช่น กระดาษ พลาสติก h) อื่นๆ( )

1._____ 2._____ 3._____ 4._____ 5._____ 6._____ 7._____ 8._____

Part II AHP analysis on print quality parameters

ชื่อ_____เพศ_____อายุ_____ชั้นปี_____คณะ_____

จงเปรียบเทียบความพอใจขอคู่พารามิเตอร์คุณภาพงานพิมพ์ และให้คะแนน โดยวิธีการวิเคราะห์แบบ AHP

		Y				
		Contrast	Resolution	Tone reproduction	Color matching	Sharpness
X	Contrast	1				
	Resolution		1			
	Tone reproduction			1		
	Color matching				1	
	Sharpness					1

scoring for category importance	
9	***X*** is much more important to the max
7	***X*** is much more important
5	***X*** is more important
3	***X*** is a bit more important
1	***X*** is almost same as ***Y***
1/3	***Y*** is a bit more important
1/5	***Y*** is more important
1/7	***Y*** is much more important
1/9	***Y*** is much more important to the max

Part III Ranking the quality of printed samples that you prefer

ชื่อ_____เพศ_____อายุ_____

ชั้นปี_____คณะ_____

จงเรียงลำดับคุณภาพของภาพพิมพ์ตัวอย่าง

1._____ 2._____ 3._____ 4._____ 5._____

APPENDIX B

T-test of factors

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	price - design	-1.83	2.45	0.35	-2.55	-1.12	-5.18	47	0.00
Pair 2	price - bindery	1.23	2.86	0.41	0.40	2.06	2.98	47	0.01
Pair 3	price - print quality	-1.94	2.70	0.39	-2.72	-1.15	-4.97	47	0.00
Pair 4	price - size	1.50	2.81	0.41	0.69	2.32	3.70	47	0.00
Pair 5	price - attractive cover	1.17	3.14	0.45	0.25	2.08	2.57	47	0.01
Pair 6	price - materials	-0.35	2.85	0.41	-1.18	0.47	-0.86	47	0.39
Pair 7	price - others	3.90	2.05	0.30	3.30	4.49	13.20	47	0.00
Pair 8	design - bindery	3.06	1.71	0.25	2.57	3.56	12.44	47	0.00
Pair 9	design - print quality	-0.15	2.01	0.29	-0.69	0.48	-0.36	47	0.72
Pair 10	design - size	3.33	1.89	0.27	2.78	3.88	12.19	47	0.00

T-test of factors

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 11	design - attractive cover	3.00	1.76	0.25	2.49	3.51	11.79	47	0.00
Pair 12	design - materials	1.48	2.20	0.32	0.84	2.12	4.65	47	0.00
Pair 13	design - others	5.73	1.22	0.18	5.38	6.09	32.65	47	0.00
Pair 14	bindery - print quality	-3.17	1.67	0.24	-3.65	-2.68	-13.16	47	0.00
Pair 15	bindery - size	0.27	2.35	0.34	-0.41	0.95	0.80	47	0.43
Pair 16	bindery - attractive cover	-0.06	2.10	0.30	-0.67	0.55	-0.21	47	0.84
Pair 17	bindery - materials	-1.58	2.31	0.33	-2.25	-0.91	-4.76	47	0.00
Pair 18	bindery - others	2.67	1.51	0.22	2.23	3.10	12.27	47	0.00
Pair 19	print quality - size	3.44	2.44	0.35	2.73	4.15	9.76	47	0.00
Pair 11	design - attractive cover	3.00	1.76	0.25	2.49	3.51	11.79	47	0.00

T-test of factors

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 20	print quality - attractive cover	3.10	2.13	0.31	2.49	3.72	10.12	47	0.00
Pair 21	print quality - materials	1.58	1.92	0.28	1.03	2.14	5.71	47	0.00
Pair 22	print quality - others	5.83	1.37	0.20	5.44	6.23	29.42	47	0.00
Pair 23	size - attractive cover	-0.33	2.13	0.31	-0.95	0.28	-1.09	47	0.28
Pair 24	size - materials	-1.85	2.33	0.34	-2.53	-1.18	-5.50	47	0.00
Pair 25	size - others	2.40	1.62	0.23	1.93	2.87	10.24	47	0.00
Pair 26	attractive cover - materials	-1.52	2.42	0.35	-2.22	-0.82	-4.35	47	0.00
Pair 27	attractive cover - others	2.73	1.70	.245	2.24	3.22	11.14	47	0.00
Pair 28	materials - others	4.25	1.63	0.24	3.78	4.72	18.06	47	0.00
Pair 20	print quality - attractive cover	3.10	2.13	0.31	2.49	3.72	10.12	47	0.00

VITA

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